Introduction

This manual provides information needed to operate and understand the vehicle and its components. More detailed information is contained in the *Owner's Warranty Information for North America* booklet, and in the vehicle's workshop and maintenance manuals.

Custom-built Freightliner vehicles are equipped with various chassis and cab components. Not all of the information contained in this manual applies to every vehicle. For details about components in your vehicle, refer to the chassis specification pages included in all new vehicles and to the vehicle specification decal, located inside the vehicle.

For your reference, keep this manual in the vehicle at all times.

IMPORTANT: Descriptions and specifications in this manual were in effect at the time of printing. Freightliner Trucks reserves the right to discontinue models and to change specifications or design at any time without notice and without incurring obligation. Descriptions and specifications contained in this publication provide no warranty, expressed or implied, and are subject to revisions and editions without notice.

Environmental Concerns and Recommendations

Whenever you see instructions in this manual to discard materials, you should first attempt to reclaim and recycle them. To preserve our environment, follow appropriate environmental rules and regulations when disposing of materials.

Event Data Recorder

This vehicle is equipped with one or more devices that record specific vehicle data. The type and amount of data recorded varies depending on how the vehicle is equipped (such as the brand of engine, if an air bag is installed, or if the vehicle features a collision avoidance system, etc.).

Customer Assistance Center

Having trouble finding service? Call the Customer Assistance Center at 1-800-385-4357 or 1-800-FTL-HELP. Call night or day, weekdays or weekends, for dealer referral, vehicle information, breakdown coordination, or Fleetpack assistance. Our people are knowledgeable, professional, and committed to following through to help you keep your truck moving.

Reporting Safety Defects

If you believe that your vehicle has a defect which could cause a crash or could cause injury or death, you should immediately inform the National Highway Traffic Safety Administration (NHTSA) in addition to notifying Daimler Trucks North America LLC.

If the NHTSA receives similar complaints, it may open an investigation, and if it finds that a safety defect exists in a group of vehicles, it may order a recall and remedy campaign. However, NHTSA cannot become involved in individual problems between you, your dealer, or Daimler Trucks North America LLC.

To contact NHTSA, you may call the Vehicle Safety Hotline toll-free at 1-888-327-4236 (TTY: 1-800-424-9153); go to **www.safercar.gov**; or write to: Administrator, NHTSA, 1200 New Jersey Avenue, SE, Washington, DC 20590. You can also obtain other information about motor vehicle safety from **www.safercar.gov**.

Canadian customers who wish to report a safety-related defect to Transport Canada, Defect Investigations and Recalls, may telephone the toll-free hotline 1-800-333-0510, or contact Transport Canada by mail at: Transport Canada, ASFAD, Place de Ville Tower C, 330 Sparks Street, Ottawa, Ontario, Canada K1A 0N5.

For additional road safety information, please visit the Road Safety website at: **www.tc.gc.ca/roadsafety**.

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Foreword

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1

Vehicle Identification

Vehicle Specification Decal 1.1
Federal Motor Vehicle Safety Standard (FMVSS) Labels 1.1
Canadian Motor Vehicle Safety Standard (CMVSS) Labels 1.2
Tire and Rim Labels 1.2
EPA Emission Control 1.2

Vehicle Identification

Vehicle Specification Decal

The vehicle specification decal lists the vehicle model, identification number, and major component models. It also recaps the major assemblies and installations shown on the chassis specification sheet. One copy of the specification decal is attached to the driver's side sunvisor; another copy is inside the rear cover of the *Owner's Warranty Information for North America* booklet. An illustration of the decal is shown in **Fig. 1.1**.

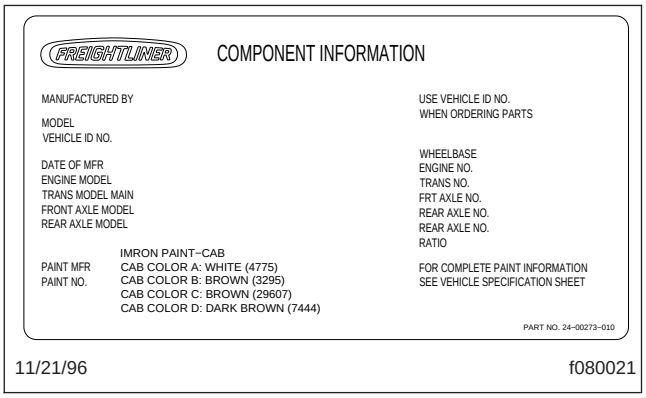


Fig. 1.1, Vehicle Specification Decal, U.S.-Built Vehicle Shown

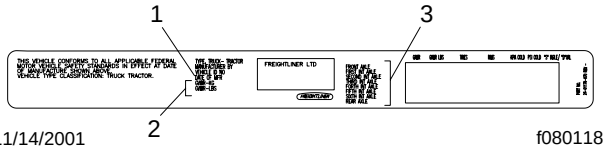
NOTE: Labels shown in this chapter are examples only. Actual specifications may vary from vehicle to vehicle.

Federal Motor Vehicle Safety Standard (FMVSS) Labels

NOTE: Due to the variety of FMVSS certification requirements, not all of the labels shown will apply to your vehicle.

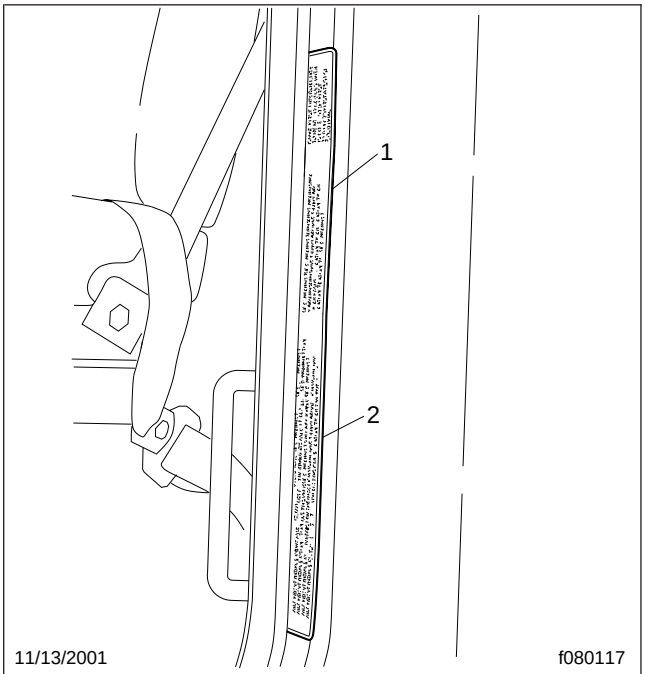
Tractors with or without fifth wheels purchased in the U.S. are certified by means of a certification statement (**Fig. 1.2**) and the tire and rim information, combined into one label. This label is attached to the left rear door post, as shown in **Fig. 1.3**.

If purchased for service in the U.S., trucks built without a cargo body have an incomplete certification label (**Fig. 1.4**) attached to the left rear door post. In addition, after completion of the vehicle, a certification label similar to that shown in **Fig. 1.2** must be attached by the final-stage manufacturer. This label will be located on the left rear door post and certifies



1. Date of Manufacture: by month and year
2. Gross Vehicle Weight Rating: developed by taking the sum of all the vehicle's gross axle ratings
3. Gross Axle Weight Ratings: developed by considering each component in an axle system–including suspension, axle, wheels, and tires–and using the lowest component capacity as the value for the system

Fig. 1.2, Certification Statement, U.S.



1. Tire and Rim Information
2. Certification Statement

Fig. 1.3, Label Location

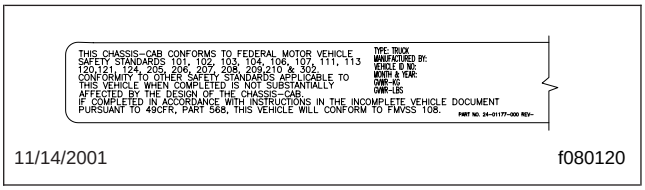

THIS CHASSIS–CAB CONFORMS TO FEDERAL MOTOR VEHICLE SAFETY STANDARDS 101, 102, 103, 104, 106, 107, 111, 113 120,121, 124, 205, 206, 207, 208, 209,210 & 302. CONFORMITY TO OTHER SAFETY STANDARDS APPLICABLE TO THIS VEHICLE WHEN COMPLETED IS NOT SUBSTANTIALLY AFFECTED BY THE DESIGN OF THE CHASSIS–CAB. IF COMPLETED IN ACCORDANCE WITH INSTRUCTIONS IN THE INCOMPLETE VEHICLE DOCUMENT PURSUANT TO 49CFR, PART 568, THIS VEHICLE WILL CONFORM TO FMVSS 108.
TYPE: TRUCK
MANUFACTURED BY:
VEHICLE ID NO:
MONTH & YEAR:
GVWR–KG
GVWR–LBS
11/14/2001
f080120

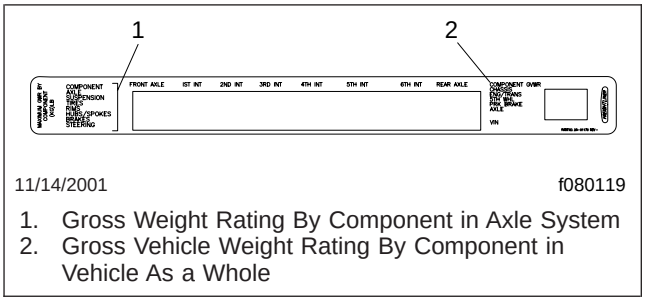
Fig. 1.4, Incomplete Vehicle Certification Label, U.S.

that the vehicle conforms to all applicable FMVSS regulations in effect on the date of completion.

Canadian Motor Vehicle Safety Standard (CMVSS) Labels

In Canada, tractors with fifth wheels are certified by means of a "Statement of Compliance" label and the Canadian National Safety Mark (**Fig. 1.5**), which are attached to the left rear door post. In addition, tire and rim information (**Fig. 1.6**) is also included in the label attached to the left rear door post.

Fig. 1.5, Canadian National Safety Mark



1. Gross Weight Rating By Component in Axle System
2. Gross Vehicle Weight Rating By Component in Vehicle As a Whole

Fig. 1.6, Tire and Rim Information

If purchased for service in Canada, trucks built without a cargo body and tractors built without a fifth wheel are certified by a "Statement of Compliance" label, similar to **Fig. 1.2**. This label must be attached by the final-stage manufacturer after completion of the vehicle. The label is located on the left rear door post, and certifies that the vehicle conforms to all applicable CMVSS regulations in effect on the date of completion.

Tire and Rim Labels

Tire and rim labels certify suitable tire and rim combinations that can be installed on the vehicle, for the given gross axle weight rating. Tires and rims installed on the vehicle at the time of manufacture may have a higher load capacity than that certified by the tire and rim label. If the tires and rims currently on the vehicle have a lower load capacity than that shown on the tire and rim label, then the tires and rims determine the load limitations on each of the axles.

See **Fig. 1.6** for U.S. and Canadian tire and rim labels.

EPA Emission Control

Vehicle Noise Emission Control Label

A vehicle noise emission control label (**Fig. 1.7**) is attached either to the left side of the dashboard or to the top-right surface of the frontwall between the dash and the windshield.

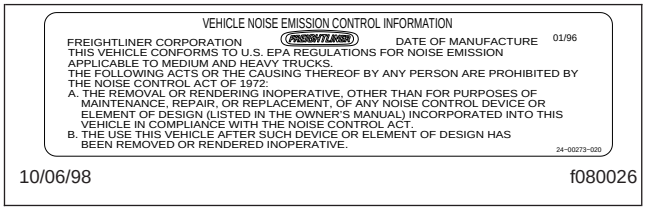

VEHICLE NOISE EMISSION CONTROL INFORMATION
FREIGHTLINER CORPORATION
DATE OF MANUFACTURE 01/96
THIS VEHICLE CONFORMS TO U.S. EPA REGULATIONS FOR NOISE EMISSION APPLICABLE TO MEDIUM AND HEAVY TRUCKS.
THE FOLLOWING ACTS OR THE CAUSING THEREOF BY ANY PERSON ARE PROHIBITED BY THE NOISE CONTROL ACT OF 1972:
A. THE REMOVAL OR RENDERING INOPERATIVE, OTHER THAN FOR PURPOSES OF MAINTENANCE, REPAIR, OR REPLACEMENT, OF ANY NOISE CONTROL DEVICE OR ELEMENT OF DESIGN (LISTED IN THE OWNER'S MANUAL) INCORPORATED INTO THIS VEHICLE IN COMPLIANCE WITH THE NOISE CONTROL ACT.
B. THE USE THIS VEHICLE AFTER SUCH DEVICE OR ELEMENT OF DESIGN HAS BEEN REMOVED OR RENDERED INOPERATIVE.
24-00273-020
10/06/98
f080026

Fig. 1.7, Vehicle Noise Emission Control Label

IMPORTANT: Certain Freightliner incomplete vehicles may be produced with incomplete noise control hardware. Such vehicles will not have a vehicle noise emission control information label. For such vehicles, it is the final-stage manufacturer's responsibility to complete the vehicle in conformity to U.S. EPA regulations (40 CFR Part 205) and label it for compliance.

EPA07 and EPA10 Emission Control

To meet EPA07 and EPA10 emissions regulations for vehicles domiciled in the USA or Canada, engines manufactured after December 31, 2006 (EPA07) or December 31, 2009 (EPA10) are equipped with an emission aftertreatment system. Vehicles domiciled outside of the USA and Canada may not have aftertreatment equipment, depending upon local statutory emissions guidelines. There is a warning label (placement will vary), for important new warning indicators in the driver's message display, that pertain to the aftertreatment system.

Vehicle Identification

It is a violation of US federal law to alter exhaust plumbing or aftertreatment in any way that would bring the engine out of compliance with certification requirements. (Ref: 42 U.S.C. S7522(a) (3).) It is the owner's responsibility to maintain the vehicle so that it conforms to EPA regulations.

2

Vehicle Access

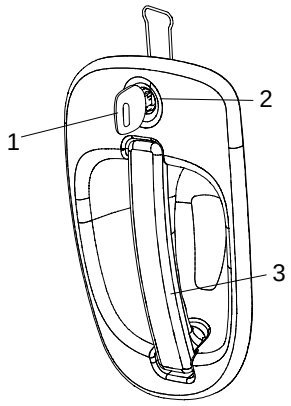
Cab Door Locks and Handles 2.1
Grab Handles and Access Steps 2.1
Cab Entry and Exit, Vehicles With Two Steps 2.2
Cab Entry and Exit, Vehicles With One Step 2.4
Back-of-Cab Access 2.5
Battery Access 2.6
Hood Opening and Closing 2.7
Fuse Identification 2.8

Cab Door Locks and Handles

One key operates the ignition switch and all of the door locks.

IMPORTANT: Each key is numbered. Record the number so a duplicate key can be made, if needed.

To unlock the driver's door from outside the cab, insert the key in the lockset and turn it one-quarter turn clockwise (**Fig. 2.1**). To remove the key, turn it counterclockwise to its original position. Pull out on the door pull handle to open the door.



10/22/2001 f720397

1. Key
2. Lock
3. Door Pull Handle

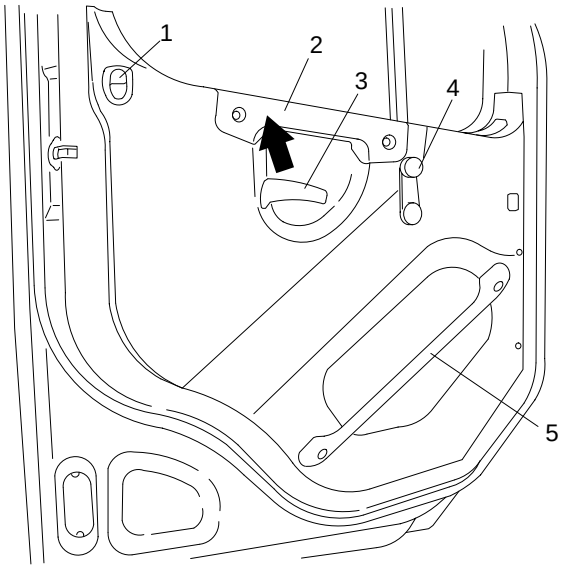
Fig. 2.1, Exterior Door Handle

To unlock the passenger's door from outside the cab, insert the key in the lockset and turn it one-quarter turn counterclockwise. Turn the key clockwise to the original position to remove it.

NOTE: The cab door locks can be operated when the doors are open.

To lock a door from outside the cab, do either one of the following:

- Insert the key in the lockset and turn it in the direction opposite to the unlocking direction (counterclockwise for the driver's door, clockwise for the passenger's door). Close the door if it is open.
- Push down the inside lock button (**Fig. 2.2**). Close the door.



10/25/2001 f720398

To open the door from the inside, lift up on the door lever (arrow).

1. Lock Button
2. Armrest/Handle
3. Door Lever
4. Window Crank
5. Inner Door Grab Handle (optional)

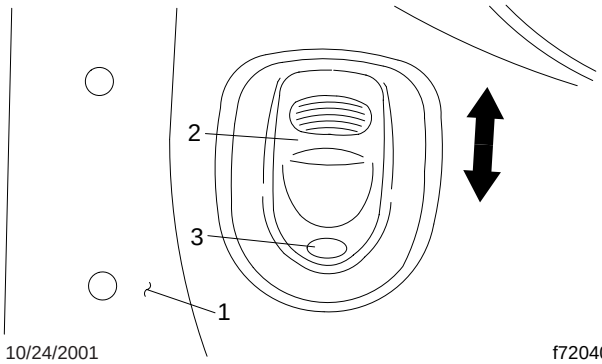
Fig. 2.2, Door Interior

To open the door from the inside, lift up on the door lever. This will unlatch the door whether or not it is locked. If it is open, close the door by pulling the inner door grab handle.

To lock either door from inside the cab, slide the lock button downwards (**Fig. 2.3**). To unlock the door without unlatching it, push the lock button upwards. A red dot will show below the lock button when it is unlocked.

Grab Handles and Access Steps

For ease of entry and exit, there are three grab handles, one on the A-pillar, one on the inner B-pillar, and an optional one on the inside of the door. In addition, the steering wheel may be used to provide secure handholds. There are one or two access steps to provide secure footholds.



Move the button down to lock, and up to unlock (arrows). The door is unlocked when the red dot shows.

1. Door
2. Lock Button
3. Red Dot

Fig. 2.3, Door Lock Button

NOTE: The A-pillar grab handle is not installed on the driver's side.

The grab handles, access steps, and steering wheel are all part of the cab access system. Use these "helping hands" when getting into, or out of, the cab. They will increase your security and comfort.

Cab Entry and Exit, Vehicles With Two Steps

⚠ WARNING

Wet or dirty shoe soles greatly increase the chance of slipping or falling. If your soles are wet or dirty, be especially careful when climbing onto, or down from, the back-of-cab area.

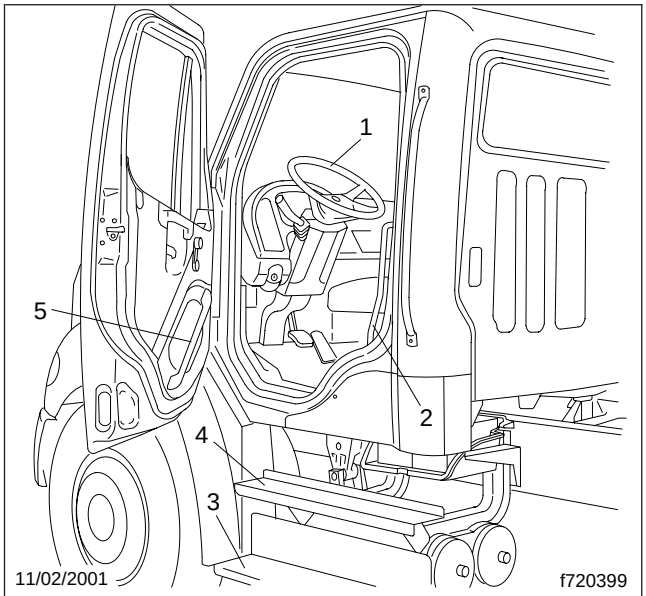
Always maintain three-point contact with the back-of-cab access supports while entering and exiting the back-of-cab area. Three-point contact means both feet and one hand, or both hands and one foot, on the grab handles, steps, and deck plates. Other areas are not meant to support back-of-cab access, and grabbing or stepping in the wrong place could lead to a fall, and personal injury.

Be careful not to get hands or feet tangled in hoses or other back-of-cab equipment. Carelessness could cause a person to trip and fall, with possible injury.

Use the cab access system (grab handles, access steps, and steering wheel) to enter or exit the cab.

Entering from the Driver's Side

To enter the cab from the driver's side, do the following steps (**Fig. 2.4**):



1. Steering Wheel
2. B-Pillar Grab Handle
3. Bottom Step
4. Top Step
5. Inner Door Grab Handle (optional)

Fig. 2.4, Cab Access System, Driver's Side

1. Use the door pull handle to open the driver's door, and place anything that you are carrying in the cab.
2. Grasp the B-pillar grab handle with both hands. Reach up as far as is comfortable.
3. Place your right foot on the bottom step, and pull yourself up.
4. Place your left foot on the top step.
5. Grasp the steering wheel with your left hand, and step up.
6. Step into the cab with your right foot first, and grasp the steering wheel with your right hand.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Exiting from the Driver's Side

To exit the cab from the driver's side, do the following steps (**Fig. 2.4**):

IMPORTANT: Do not attempt to exit the cab while carrying any items in your hands.

1. If you wish to take any items with you, after you exit the cab, place them in an accessible location on the seat or cab floor. Make sure they will not get in your way as you exit.

⚠ WARNING

Always face in when exiting the cab. Do not attempt to exit with your back to the cab, as you would going down a flight of stairs. It is easier to slip or lose your balance. If you slip when exiting in this way, there is a greater likelihood of personal injury.

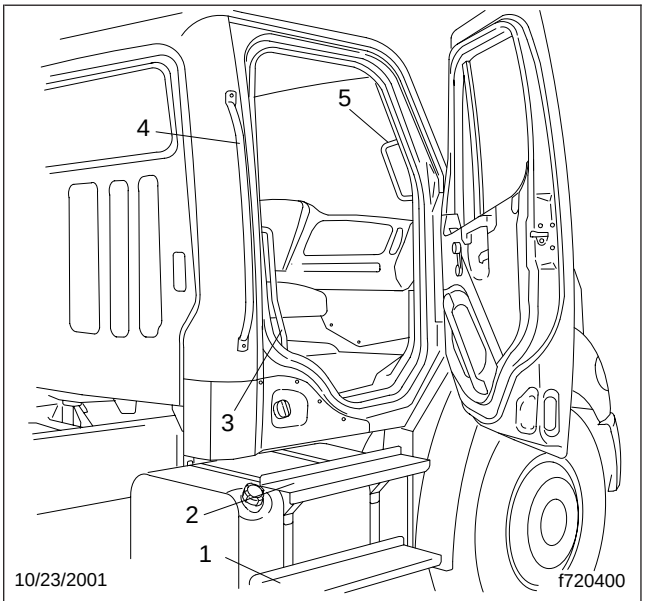
2. Grasp the steering wheel with both hands. Place your left foot on the top step, and stand on the threshold, facing into the cab.
3. Move your right hand to the B-pillar grab handle.
4. Move your right foot to the bottom step.
5. Move your left hand to the B-pillar grab handle.
6. Step to the ground with your left foot first.
7. Retrieve from the cab any items that you wish to take with you.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Entering from the Passenger's Side

To enter the cab from the passenger's side, do the following steps (**Fig. 2.5**):

1. Open the passenger's door, and place anything that you are carrying in the cab.
2. Grasp the B-pillar grab handle on the door with both hands.



1. Bottom Step
2. Top Step
3. B-Pillar Grab Handle
4. Sidewall Grab Handle (optional)
5. A-Pillar Cover Grab Handle

Fig. 2.5, Cab Access System, Passenger's Side and Back of Cab

3. Place your left foot on the bottom step and step up to the upper step with your right foot.
4. Move your right hand to the A-pillar cover grab handle.
5. Place your left foot on the top step and step up.
6. Move your left hand to the A-pillar cover grab handle.
7. Step into the cab with your left foot first.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Exiting from the Passenger's Side

To exit the cab from the passenger's side, do the following steps (**Fig. 2.5**):

IMPORTANT: Do not attempt to exit the cab while carrying any items in your hands.

1. If you wish to take any items with you, after you exit the cab, place them in an accessible location

on the seat or cab floor. Make sure they will not get in your way as you exit.

⚠ WARNING

Always face in when exiting the cab. Do not attempt to exit with your back to the cab, as you would going down a flight of stairs. It is easier to slip or lose your balance. If you slip when exiting in this way, there is a greater likelihood of personal injury.

2. Grasp the A-pillar cover grab handle with both hands, then place your right foot on the top step while standing up from the seat facing inward.
3. Place your left foot on the top step.
4. Move your left hand to the B-pillar grab handle.
5. Move your left foot to the bottom step.
6. Move your right hand to the B-pillar grab handle.
7. Step to the ground with your right foot first.
8. Retrieve from the cab any items that you wish to take with you.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Cab Entry and Exit, Vehicles With One Step

⚠ WARNING

Wet or dirty shoe soles greatly increase the chance of slipping or falling. If your soles are wet or dirty, be especially careful when climbing onto, or down from, the back-of-cab area.

Always maintain three-point contact with the back-of-cab access supports while entering and exiting the back-of-cab area. Three-point contact means both feet and one hand, or both hands and one foot, on the grab handles, steps, and deck plates. Other areas are not meant to support back-of-cab access, and grabbing or stepping in the wrong place could lead to a fall, and personal injury.

Be careful not to get hands or feet tangled in hoses or other back-of-cab equipment. Carelessness could cause a person to trip and fall, with possible injury.

Use the cab access system (grab handles, access steps, and steering wheel) to enter or exit the cab.

Entering from the Driver's Side

To enter the cab from the driver's side, do the following steps (**Fig. 2.4**):

1. Use the door pull handle to open the driver's door, and place anything that you are carrying in the cab. Use the door armrest/handle and, if available, the inner door grab handle, as a support if needed.
2. Grasp the B-pillar grab handle with both hands. Reach up as far as is comfortable.
3. Place your right foot on the step, and pull yourself up.
4. Step into the cab with your left foot.
5. Grasp the steering wheel with your left hand.
6. Step into the cab with your right foot, and grasp the steering wheel with your right hand.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Exiting from the Driver's Side

To exit the cab from the driver's side, do the following steps (**Fig. 2.4**):

IMPORTANT: Do not attempt to exit the cab while carrying any items in your hands.

1. If you wish to take any items with you, after you exit the cab, place them in an accessible location on the seat or cab floor. Make sure they will not get in your way as you exit.

⚠ WARNING

Always face in when exiting the cab. Do not attempt to exit with your back to the cab, as you would going down a flight of stairs. It is easier to slip or lose your balance. If you slip when exiting in this way, there is a greater likelihood of personal injury.

2. Grasp the steering wheel with both hands. Place your left foot on the step, and stand on the threshold, facing into the cab.
3. Move your right hand to the B-pillar grab handle.
4. Move your left hand to the B-pillar grab handle.
5. Move your right foot onto the step.
6. Step to the ground with your left foot first.
7. Retrieve from the cab any items that you wish to take with you.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Entering from the Passenger's Side

To enter the cab from the passenger's side, do the following steps (**Fig. 2.5**):

1. Open the passenger's door, and place anything that you are carrying in the cab.
2. Grasp the B-pillar grab handle with both hands.
3. Place your left foot on the step and step up to the cab with your right foot.
4. Move your right hand to the A-pillar cover grab handle.
5. Move your left hand to the A-pillar cover grab handle.
6. Step into the cab with your left foot.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Exiting from the Passenger's Side

To exit the cab from the passenger's side, do the following steps (**Fig. 2.5**):

IMPORTANT: Do not attempt to exit the cab while carrying any items in your hands.

1. If you wish to take any items with you, after you exit the cab, place them in an accessible location on the seat or cab floor. Make sure they will not get in your way as you exit.

⚠ WARNING

Always face in when exiting the cab. Do not attempt to exit with your back to the cab, as you would going down a flight of stairs. It is easier to slip or lose your balance. If you slip when exiting in this way, there is a greater likelihood of personal injury.

2. Grasp the A-pillar cover grab handle with both hands, then place your right foot on the step while standing up from the seat facing inward.
3. Place your left foot on the step.
4. Move your left hand to the B-pillar grab handle.
5. Move your right hand to the B-pillar grab handle.
6. Step to the ground with your right foot first.
7. Retrieve from the cab any items that you wish to take with you.

NOTE: You can also use the inner door grab handle, if available, as a support when getting up or down from the bottom step.

Back-of-Cab Access

When trailer air and electrical connections cannot be reached conveniently from the ground, Federal Motor Carrier Safety Regulations require commercial carriers to provide back-of-cab access.

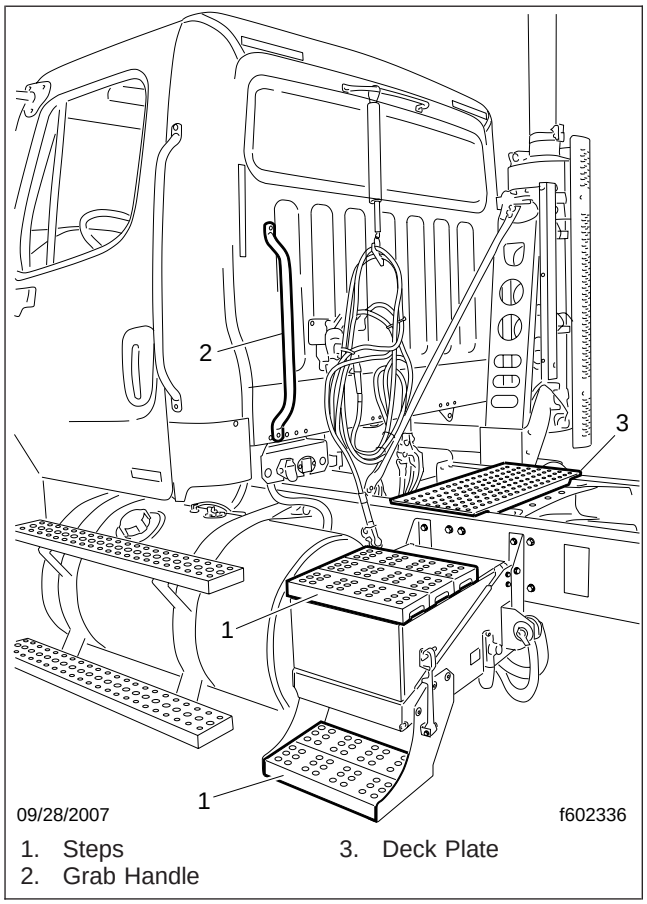
Optional grab handles are mounted on each cab sidewall, or on the left sidewall only. See **Fig. 2.6**. Steps are mounted either on the fuel tank(s) or on metal brackets. When a deck plate is necessary, it is mounted across the top of the frame rails.

IMPORTANT: Climb onto, and down from, back-of-cab access facing in toward the vehicle, as you would on a ladder. Do not climb up or down facing out away from the vehicle.

⚠ WARNING

Wet or dirty shoe soles greatly increase the chance of slipping or falling. If your soles are wet or dirty, be especially careful when climbing onto, or leaving, the back-of-cab area.

Always maintain three-point contact with the back-of-cab access supports while entering and



1. Steps
2. Grab Handle
3. Deck Plate

Fig. 2.6, Back-of-Cab Access Supports (typical)

exiting the back-of-cab area. Three-point contact means both feet and one hand, or both hands and one foot, on the grab handles, steps, and deck plates. Other areas are not meant to support back-of-cab access, and grabbing or stepping in the wrong place could lead to a fall, and personal injury.

Be careful not to get hands or feet tangled in hoses or other back-of-cab equipment. Carelessness could cause a person to trip and fall, with possible injury.

Entering Back-of-Cab

When climbing onto the deck plate, do the following:

1. Grasp the sidewall grab handle with both hands. Reach up as far as is comfortable.
2. Place one foot on the bottom step and pull yourself up.
3. Place your other foot on the top step.
4. Move your lower hand to a higher position on the grab handle.
5. Step onto the deck plate.

Climbing Down from Back-of-Cab

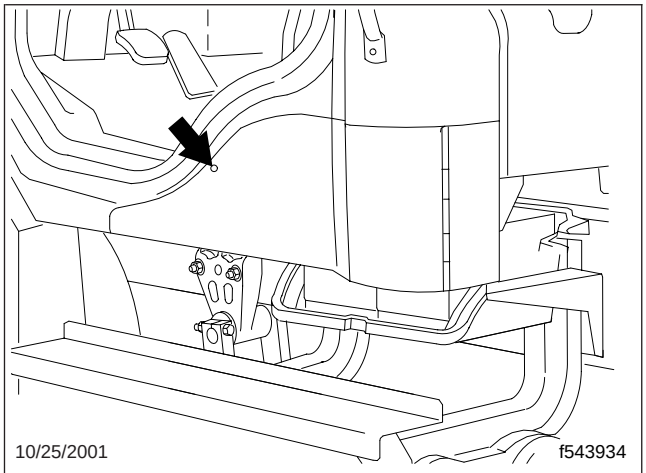
To climb down from the back-of-cab area:

1. Grasp the sidewall grab handle with both hands.
2. Step one foot at a time onto the top step.
3. Move your upper hand to a lower position on the grab handle.
4. Move one foot to the bottom step.
5. Move your upper hand to a lower position on the grab handle.
6. Step to the ground with your upper foot first.

Battery Access

Battery Compartment

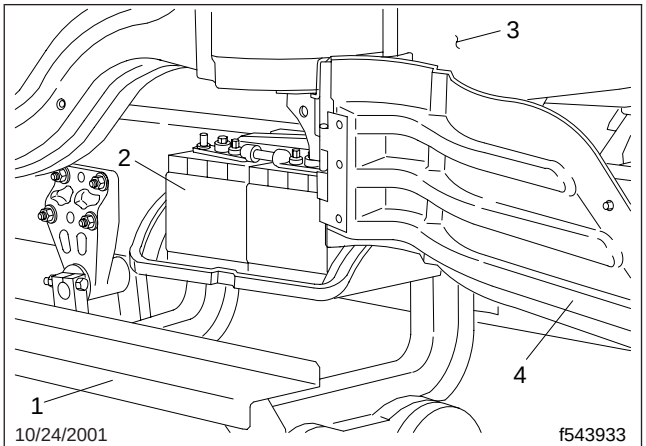
The battery compartment is located in the lower part of the cab beneath and to the rear of the driver's door. It is fastened by a quarter-turn fastener. To open the battery access door, turn the quarter-turn fastener with a small screwdriver. See **Fig. 2.7**.



Open the battery access door by turning the quarter-turn fastener (arrow) with a small screwdriver.

Fig. 2.7, Battery Compartment, Closed

With the battery access door open (**Fig. 2.8**), it is easy to get access to the battery terminals for cleaning, charging, or emergency jump starting.



1. Top Step
2. Battery
3. Cab
4. Battery Access Door

Fig. 2.8, Battery Compartment, Open

To close the battery access door, do the following steps:

1. Swing the battery access door to line up the quarter-turn fastener with the hole in the cab door frame.
2. Close the battery access door and check to be sure the quarter-turn fastener is engaged with the hole.
3. Turn the fastener one-quarter turn.

Cab (Battery) Isolation Switch

The cab isolation switch (see **Fig. 2.9**) is located on the cab floor at the left of the driver's seat, or inside the battery box. The battery isolation switch reduces the power to the cab and engine power wiring. Use it whenever the vehicle is to be put out of service for extended periods.

IMPORTANT: The battery disconnect switch does not completely isolate the batteries from the electrical system. For service operations that require that the batteries be disconnected, always shut down the engine and remove the negative battery cables.

NOTE: Whenever battery power is disconnected, clocks and electronically tuned radios must be reset.

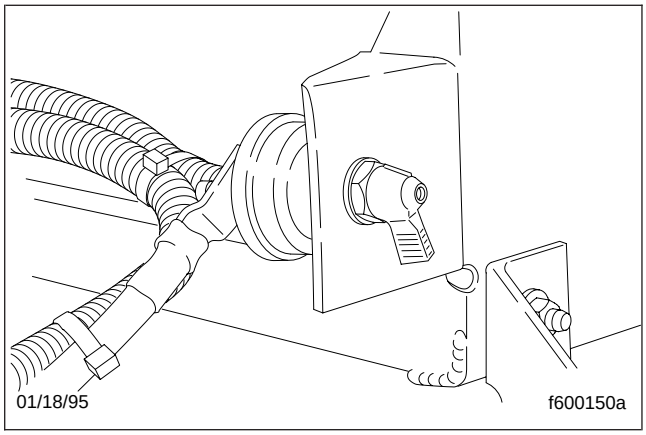


Fig. 2.9, Cab (Battery) Isolation Switch

Hood Opening and Closing

The hood can be raised to a full-open position. A torsion bar helps you to raise the hood, and to lower it to the operating position. Hood restraint cables prevent the hood from overtravel. A hood damper limits the closing speed. In the operating position, the hood is secured to the cab-mounted half-fenders by a hold-down latch on each side of the hood.

To Open the Hood

1. Apply the parking brakes.
2. Release both hood hold-down latches by pulling the ends outward. See **Fig. 2.10**.

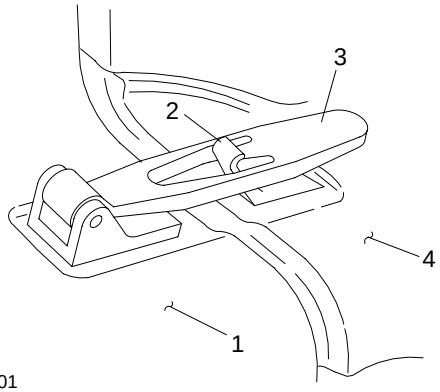
⚠ CAUTION

Do not let the hood free-fall to the full-open position. To do so could cause damage to the hood or hood straps.

3. Standing in front of the hood, raise the rear of the hood upward until it reaches the over-center position (45 degrees from vertical). Then slowly bring it to a stop.

To Close the Hood

1. Push the hood over center.



1. Fender
2. Latch Hook
3. Latch Handle
4. Half-Fender

Fig. 2.10, Hood Hold-Down Latch

2. As the hood goes over center, the damper automatically slows its rate of descent. If needed, you can also slow its rate of descent with your hand.
3. Make sure the hood is flush with the cowl, then secure the hood by engaging both hood hold-down latches.

IMPORTANT: Make sure that both hold-down latches are fully engaged before operating the vehicle.

Fuse Identification

Main Fuse Box/PDM

The main fuse box, also known as the power distribution module, or PDM, is located under the hood on the left front fender just forward of the bulkhead module. See **Fig. 2.11**. To open the fuse box, pull down on the wire clips holding the lid on the fuse box.

A sticker inside the lid of the fuse box shows the locations of the fuses and describes the circuit(s) that each fuse protects (see **Fig. 2.12**). See **Table 2.1** for descriptions of a typical set of fuses. The fuses in the main fuse box are mini blade-type fuses. Battery power fuses, located near the batteries, are bolt-in megafuses.

Because the electrical system is multiplexed, no relays are needed. The multiplexing module performs the functions normally provided by relays.

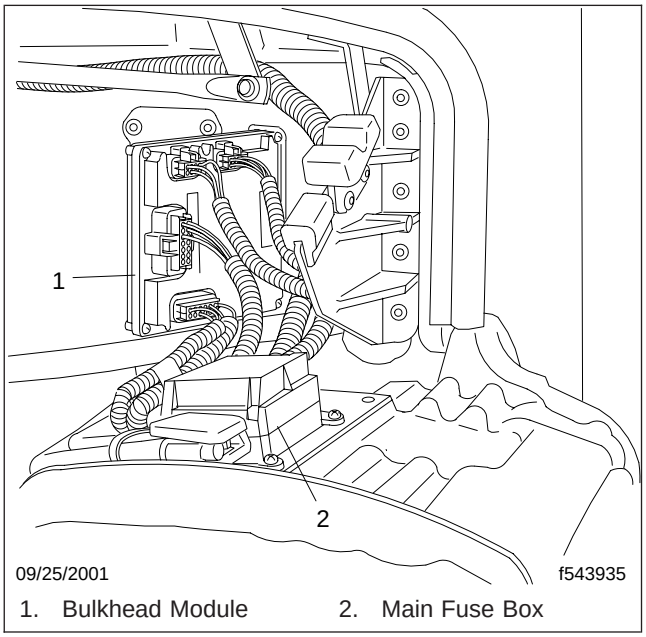
Fuse Identification, Main Fuse Box			
Pos. No.	**Description**	**Fuse Color**	**Rating**
F1	VCU (MBE900 only)	Red	10 Amp
F2	Blower Motor	Green	30 Amp
F3	Engine ECU	Yellow	20 Amp
F4	Transmission Control Unit	Green	30 Amp
F5	Ignition Switch	Tan	5 Amp
F6	Spare	—	—
F7	Bulkhead Module	Green	30 Amp
F8	ICU	Red	10 Amp
F9	Transmission Control Unit	Yellow	20 Amp
F10	Door Locks (optional)	Red	10 Amp
F11	Mirrors (optional)	Blue	15 Amp
F12	Radio/Diagnostics	Yellow	20 Amp
F13	Chassis Module	Green	30 Amp
F14	L/H Power Windows (optional)	Blue	15 Amp
F15	Bulkhead Module	Green	30 Amp
F16	ABS ECU	Blue	15 Amp
F17	Chassis Module	Green	30 Amp
F18	Bulkhead Module	Green	30 Amp
F19	Chassis Module	Green	30 Amp
F20	Bulkhead Module	Green	30 Amp
F21	R/H Power Windows (optional)	Blue	15 Amp
F22	Bulkhead Module	Green	30 Amp
F23	Spare	—	—
F24	Spare	—	—
F25	Spare	—	—
F26	Spare	—	—
M1	Battery Power	—	125 Amp
M2	Battery Power	—	125 Amp
M3	Battery Power	—	150 Amp

Table 2.1, Fuse Identification, Main Fuse Box

Trailer and Taillight Fuse Boxes

The trailer fuse box and the taillight fuse box, on vehicles so equipped, are mounted on a bracket with the chassis module on the left-hand frame rail aft of the cab, or on a crossmember at the end of the frame rail. These may be referred to as the chassis fuse box or chassis PDM. See **Fig. 2.13** for trailer fuse and relay information, and **Fig. 2.14** for taillight fuse and relay information.

These fuse boxes contain mini blade-type fuses, 12-volt mini relays, and 12-volt micro relays.



1. Bulkhead Module 2. Main Fuse Box

Fig. 2.11, Location of the Main Fuse Box

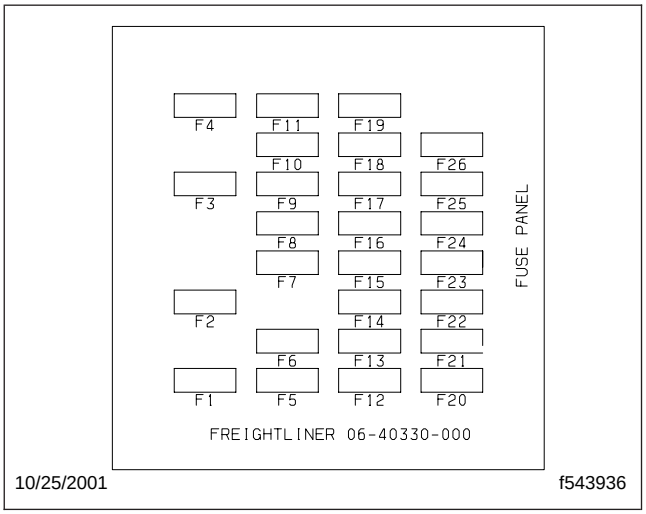


Fig. 2.12, Main Fuse Box Diagram

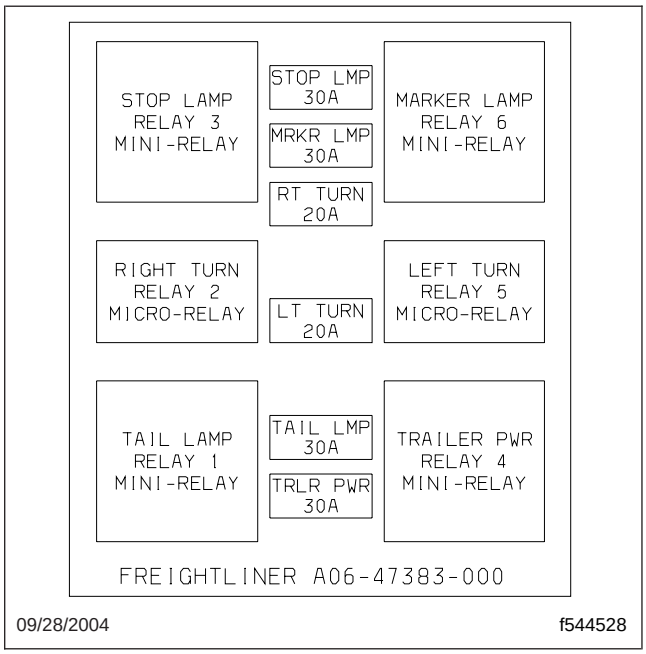


Fig. 2.13, Trailer Fuse Box Diagram

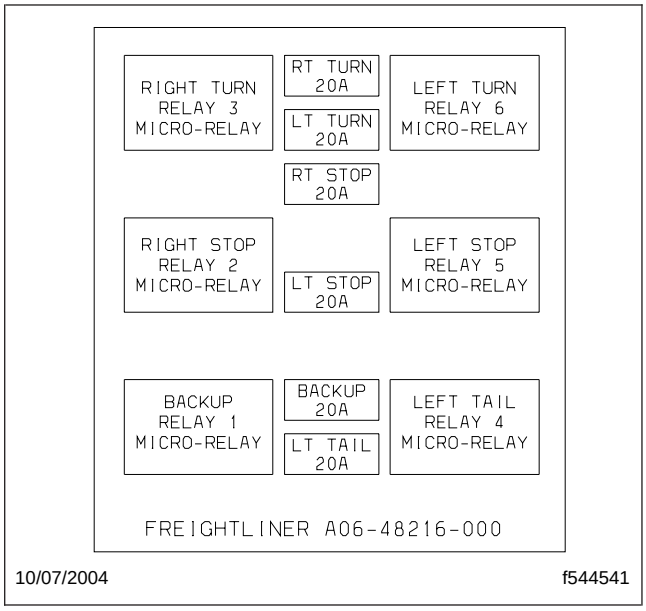


Fig. 2.14, Taillight Fuse Box Diagram

3

Instruments

Instrumentation Control Unit 3.1
Warning and Indicator Lights 3.5
Standard Instruments 3.9
Optional Instruments 3.12
Overhead Instrument Panel 3.15

Instrumentation Control Unit

The ICU3 instrument cluster is a single unit that provides the driver with engine and vehicle information. It is comprised of gauges, warning and indicator lamps, an audible warning, and a liquid crystal display (LCD) screen.

IMPORTANT: Vehicles that are domiciled outside of the U.S. and Canada may not have EPA07- or EPA10-compliant engines with an emission aftertreatment system (ATS), depending upon local jurisdictional emissions guidelines.

Figure 3.1 shows a typical ICU3 instrument cluster installed in EPA07- and EPA10-compliant vehicles.

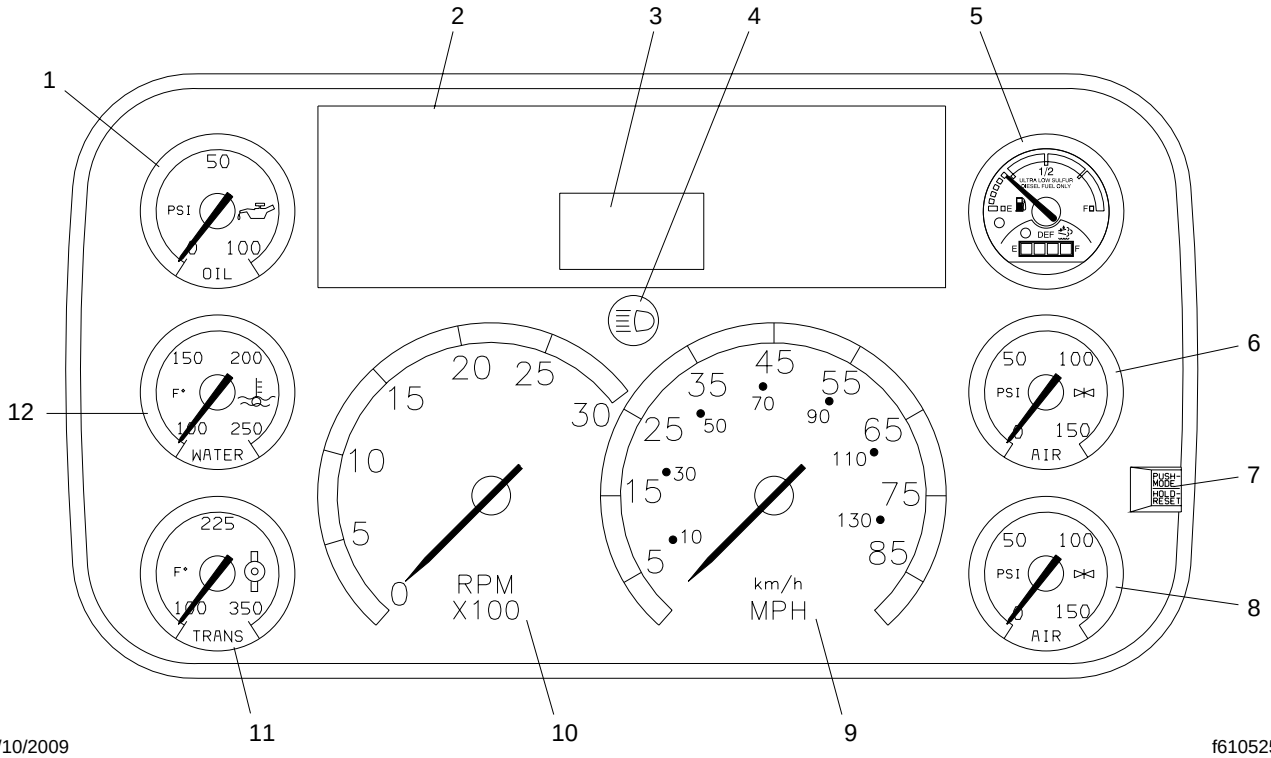
Vehicles that are not EPA10-compliant do not have a fuel/diesel exhaust fluid (DEF) gauge.

There can be up to eight gauges on the driver's instrument panel (six electronic and two mechanical). The air gauges operate mechanically.

The ICU3 also has the capability to drive up to six independent stand-alone gauges such as those installed on the auxiliary dash panel. **Figure 3.2** shows a typical dash panel layout.

Dash Message Center

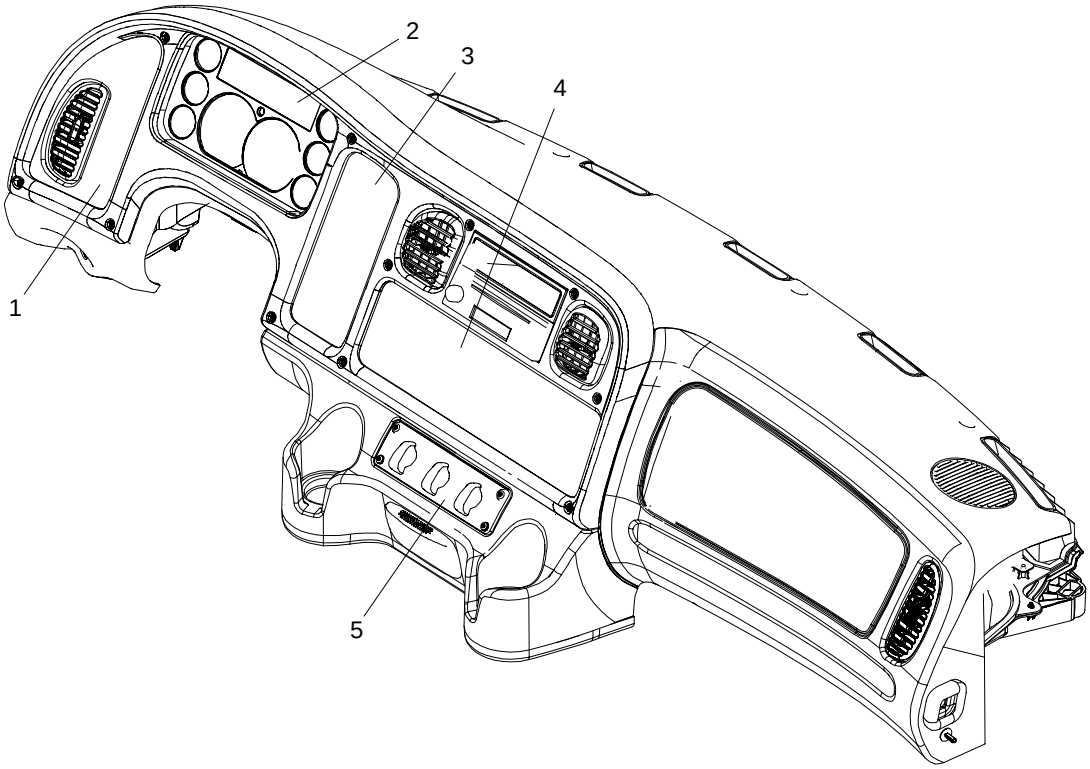
The dash message center houses all of the standard and optional warning and indicator lamps, as well as the driver display screen. The display screen has a



NOTE: This instrument cluster is shown with the U.S. speedometer, which shows miles per hour (mph) more prominently than kilometers per hour (km/h).

1. Engine Oil Pressure Gauge
2. Dash Message Center
3. Driver Display Screen
4. Headlight High-Beam Indicator
5. Fuel/DEF Level Gauge
6. Primary Air Pressure Gauge
7. Mode/Reset Button
8. Secondary Air Pressure Gauge
9. Speedometer (U.S. version)
10. Tachometer
11. Transmission Temperature Gauge
12. Coolant Temperature Gauge

Fig. 3.1, Typical Gauge Layout, U.S. (EPA10 shown)



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NOTE: Instruments and controls, and their locations, may vary from those shown.

1. Left-Hand Control Panel
2. ICU3
3. Right-Hand Control Panel
4. Auxiliary Dash Panel
5. Climate Control Panel

Fig. 3.2, Dash Panel Layout (typical)

7-character LCD that normally shows odometer readings and, below that, a smaller 3-character LCD that shows voltmeter readings. Warning messages and diagnostic fault codes will also appear in the display screen.

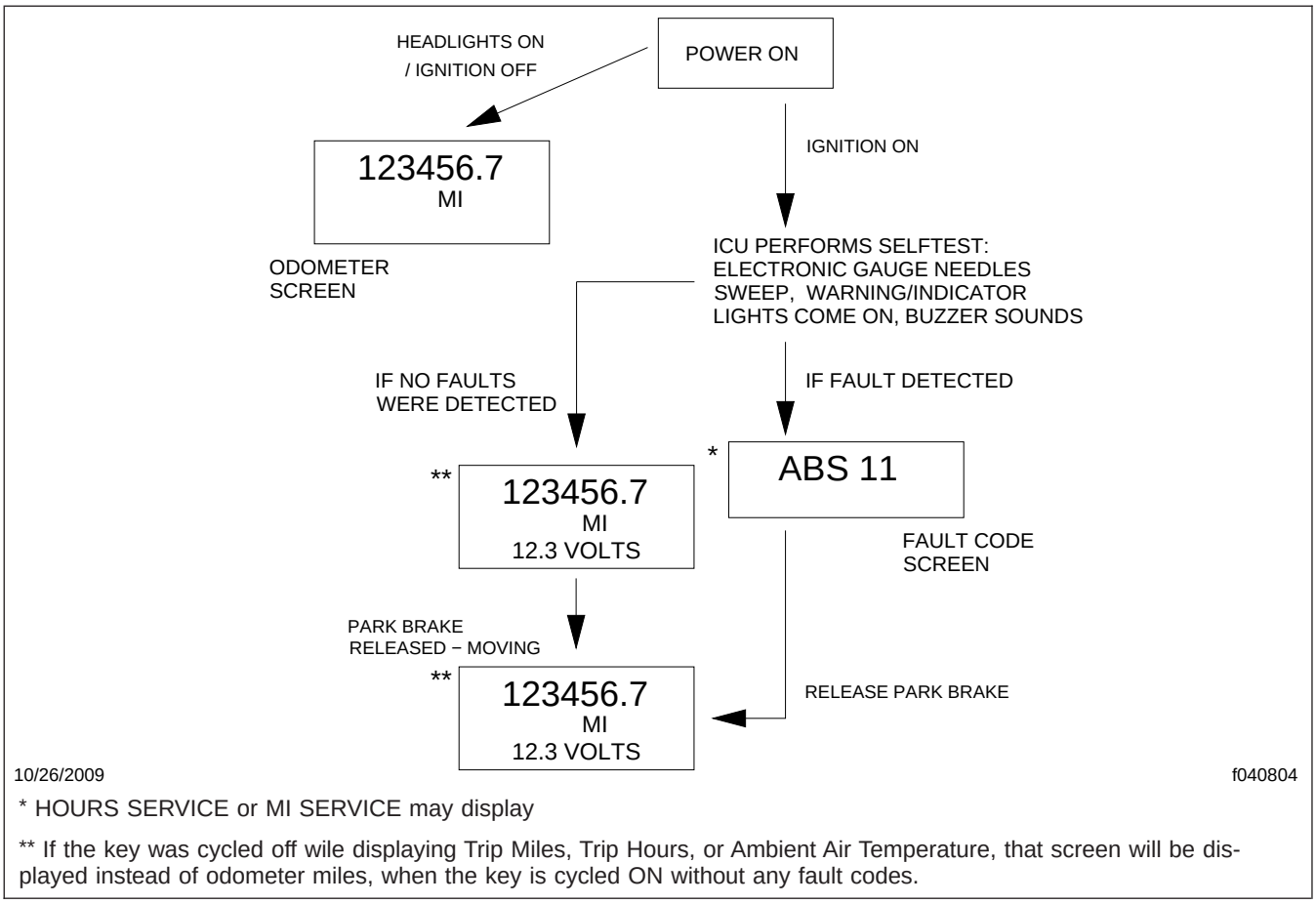
Information provided by the driver display screen includes:

- odometer readings (in miles or kilometers)
- trip and total engine distance
- trip and total engine hours
- service screens
- fault code displays
- warning messages

Ignition Sequence

When the ignition is turned on, the ICU3 runs through the ignition sequence. See **Fig. 3.3**. First, the ICU3 performs a self-test, looking for active fault codes and displays them, if any, one after the other until the engine is started or the ignition switch is turned off. If there are no active fault codes, the driver display screen displays the odometer.

When the ignition is first turned on, all the electronic gauges complete a full sweep of their dials, the warning and indicator lamps illuminate, and the audible warning sounds for three seconds. On EPA10-compliant vehicles, the DEF level indicator illuminates all segments green, then turns them off one at a time before turning the left most segment amber then red.



* HOURS SERVICE or MI SERVICE may display

** If the key was cycled off wile displaying Trip Miles, Trip Hours, or Ambient Air Temperature, that screen will be displayed instead of odometer miles, when the key is cycled ON without any fault codes.

Fig. 3.3, Ignition Sequence

NOTE: The air gauges do not sweep.

NOTE: If active fault codes are present, take the vehicle to an authorized Freightliner service facility as soon as possible.

If the fault is a serious problem that requires immediate attention, the engine protection system will activate. In most cases, the check engine light will illuminate also.

If service miles or service hours has been exceeded, either **Fig. 3.4** or **Fig. 3.5** will come up before the fault screen (if fault codes are present). If no fault codes are present and service hours or miles are exceeded, either **Fig. 3.4** or **Fig. 3.5** will stay displayed until the parking brake is released with the engine running, or the mode/reset button is pressed.

Fig. 3.4, Service Hours Exceeded

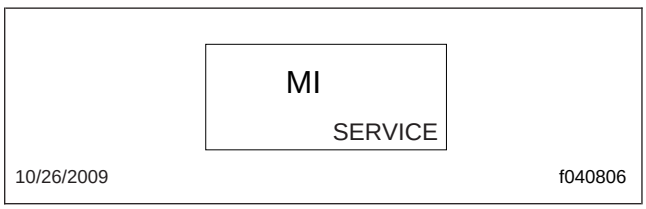


Fig. 3.5, Service Miles Exceeded

Odometer

The odometer is set to display in either miles or kilometers, depending on the primary scale of the speedometer. The legend, either **MI** or **KM**, illuminates between the odometer and the volts display when the engine is running or the headlights are on.

The odometer is a 7-digit display with a decimal point until the vehicle has traveled 999,999.9 miles or kilometers (km). At one million miles (km), the odometer rolls over to "1000000" without the decimal point, and can continue up to 9,999,999. The odometer only displays significant figures (no leading zeros).

Mode/Reset Button

The mode/reset button (**Fig. 3.6**) is located on the right side of the instrument cluster. The mode/reset button is used to scroll through the displays on the driver display screen, and to reset the trip distance and trip hours values to zero.

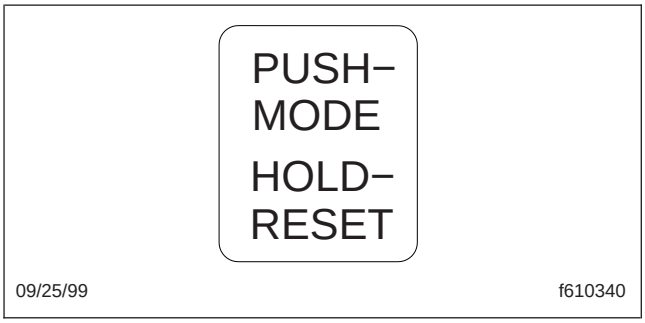


Fig. 3.6, Mode/Reset Button

Functions

When the parking brake is off, pressing the mode/reset button will scroll through the following screens:

i. Trip distance
ii. Trip hours
iii. Outside temperature
iv. Back to odometer

When the parking brake is set, pressing the mode/reset button will scroll through the following screens:

i. Trip distance
ii. Trip hours
iii. Outside temperature
iv. Select screen
v. Temperature alert screen
vi. Diagnostic screen
vii. Clear screen (with less than 254 miles)
viii. Engine miles
ix. Engine hours
x. Setup screen
xi. Back to odometer

Trip Miles

To reset trip miles and/or trip hours to zero, press the mode/reset button for one second or longer.

Miles or Kilometers

To toggle between MI (miles) or KM (kilometers), press the mode/reset button while in the Select screen.

Audible Warnings

An audible warning sounds during the ignition sequence and whenever one of the following conditions exist:

- Engine oil pressure falls below the minimum level shown in **Table 3.1**.
- Coolant temperature rises above the maximum temperature shown in **Table 3.2**.
- Air pressure falls below approximately 70 psi (483 kPa).
- Parking brake is set with the vehicle moving at a speed greater than two miles per hour.
- System voltage falls below 12.0 volts.
- Door is open and the parking brake is off.
- Occupied seat belts are not fastened and the parking brake is off.
- Outside temperature falls below 35°F (1.7°C).

Minimum Oil Pressure*		
Engine Model	**At Idle Speed: psi (kPa)**	**At Rated RPM: psi (kPa)**
Caterpillar	10–20 (69–138)	30–45 (207–310)
Cummins	15 (103)	35 (241)

Minimum Oil Pressure*		
Engine Model	**At Idle Speed: psi (kPa)**	**At Rated RPM: psi (kPa)**
Detroit Diesel	14 (97)	55 (350)
Mercedes-Benz	7 (50)	36 (250)

* Oil pressures are given with the engine at operating temperature. With the engine cold, oil pressure may be higher. Individual engines may vary from the listed pressures; observe and record pressures when the engine is new to create a guide for checking engine condition.

Table 3.1, Minimum Oil Pressure

Maximum Coolant Temperature	
Engine Make	**Temperature: °F (°C)**
Caterpillar	230 (110)
Cummins	225 (107)
Detroit Diesel	215 (101)
Mercedes-Benz	222 (105)

Table 3.2, Maximum Coolant Temperature

Warning and Indicator Lights

There can be up to 28 warning and indicator lamps installed in the dash message center. See **Fig. 3.7** for pre-EPA07 engines, **Fig. 3.8** for EPA07 engines, or **Fig. 3.9** for EPA10 engines.

The lamps, or telltales, in the top row are optional. The lamps on the other three rows are installed at fixed positions that do not vary. If an optional lamp is not requested, the position is blank.

See **Table 3.3** for a list of standard and commonly used warning and indicator lamps.

Engine Protection System

If a critical engine condition exists (for example, low engine oil pressure, low coolant level, high coolant temperature, high diesel particulate filter soot level, or uncontrolled regeneration), the CHECK engine lamp will illuminate to alert the driver to correct the condition as soon as possible. If the condition worsens, the STOP engine lamp will illuminate.

NOTE: If the CHECK engine lamp illuminates during vehicle operation, take the vehicle directly to an authorized Freightliner service facility.

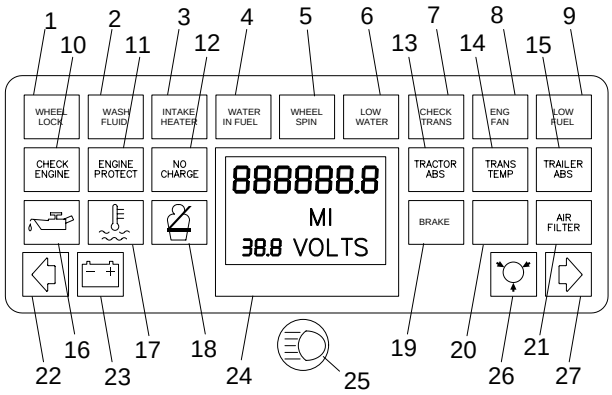
WARNING

When the red STOP engine lamp illuminates, most engines are programmed to shut down automatically within 30 seconds. The driver must immediately move the vehicle to a safe location at the side of the road to prevent causing a hazardous situation that could cause bodily injury, property damage, or severe damage to the engine.

The STOP engine lamp illuminates when the engine protection system is activated. The engine protection system typically works as follows, depending on the engine type. Some vehicles may have a shutdown-override switch, which may be used to momentarily override the shutdown sequence. See **Chapter 7** for more information.

- On some engines, the engine protection system will derate the engine, allowing it to run at lower rpm and slower vehicle speed—drive the vehicle to a safe location or to a service facility.
- On other engines, the engine protection system will shut down the engine. It will first derate the engine, then shut it down completely 30 to 60 seconds after the indicator illuminates (depending on the critical fault type) if the condition does not improve.

  Bring the vehicle to a stop on the side of the road before the engine shuts down. Do not attempt to restart the engine while the vehicle is moving. To restart the engine, turn the ignition switch to OFF, leave it there a few seconds, then turn the switch to START. The engine will run for a short period and shut down again if the condition does not improve.



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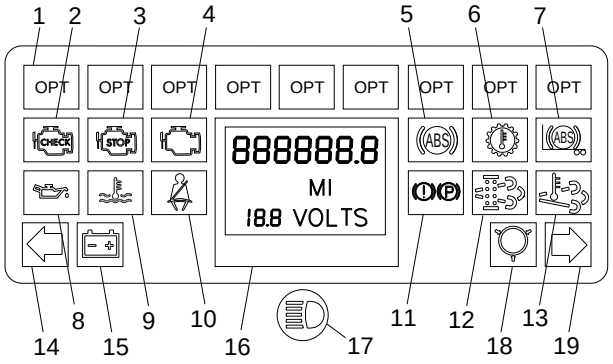
Typical installation shown. Location of legends installed in the top row may vary, and other legends may be specified.

1. Wheel Lock Warning
2. Low Washer Fluid Indicator
3. Intake Heater On Indicator
4. Water In Fuel Indicator
5. Wheel Spin Indicator
6. Low Coolant Warning
7. Check Transmission Indicator
8. Engine Fan On Indicator
9. Low Fuel Warning
10. Check Engine Indicator
11. Engine Protection Warning
12. No Charge Indicator
13. Tractor ABS Indicator
14. Transmission Temperature Indicator
15. Trailer ABS Indicator (as applies)
16. Low Oil Pressure Warning
17. High Coolant Temperature Warning
18. Fasten Seat Belts Warning
19. Parking Brake On Indicator
20. Not Used
21. Air Restriction Indicator
22. Left-Turn Signal
23. Low Battery Voltage Warning
24. Driver Display Screen
25. High-Beam Headlights Indicator
26. Low Air Pressure Warning
27. Right-Turn Signal

Fig. 3.7, Pre-EPA07 Dash Message Center



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Typical installation shown. Location of legends installed in the top row may vary, and other legends may be specified.

1. Optional Indicator
2. Check Engine Indicator
3. Stop Engine Indicator
4. Malfunction Indicator Light (MIL)
5. Tractor ABS Indicator
6. Transmission Temperature Indicator
7. Trailer ABS Indicator (as applies)
8. Low Oil Pressure Warning
9. High Coolant Temperature Warning
10. Fasten Seat Belt Warning
11. Parking Brake On Warning
12. DPF Status Lamp
13. High Exhaust System Temperature (HEST) Warning
14. Left-Turn Signal
15. Low Battery Voltage Warning
16. Driver Display Screen
17. High-Beam Headlights Indicator
18. Low Air Pressure Warning
19. Right-Turn Signal

Fig. 3.8, EPA07 Dash Message Center

Instruments

Common Warning and Indicator Lamps		
	CHECK Engine	Indicates a critical engine condition (low oil pressure, low coolant level, high coolant temperature, high DPF soot level, or uncontrolled DPF regeneration). Correct the condition as soon as possible. If the condition worsens, the STOP engine lamp will illuminate.
	STOP Engine	Indicates a serious fault which requires engine shutdown immediately. The engine protection system will reduce the maximum engine torque and speed, and, if the condition does not improve, will shut down the engine within 30 to 60 seconds. The driver must safely bring the vehicle to a stop on the side of the road and shut down the engine as soon as the red light is seen. If the engine shuts down while the vehicle is in a hazardous location, restart the engine after turning the key to the OFF position for a few seconds. Move the vehicle to a safer location.
	High Exhaust System Temperature (HEST)	Slow (10-second) flashing indicates a regeneration (regen) is in progress. Solid illumination indicates high exhaust temperatures at the outlet of the tail pipe, when speed is below 5 mph (8 km/h). It does not signify the need for service; it only alerts the vehicle operator to high exhaust temperatures when a regen is in progress.
	DPF Status	Solid illumination indicates a regen is required. Change to a more challenging duty cycle (such as highway driving) to raise exhaust temperatures for at least twenty minutes, or perform a parked regen. Blinking indicates that a parked regen is required immediately. An engine derate and shutdown will occur.
	Malfunction Indicator Lamp (MIL)	Indicates an emissions-related fault. See the engine operation manual for details.
	Vehicle ABS	Indicates the vehicle ABS is engaged. When ABS is not engaged. illumination indicates a problem with the vehicle ABS. Repair the ABS immediately to ensure full braking capability.
	Trailer ABS	Indicates the trailer ABS is engaged. When ABS is not engaged. illumination indicates a problem with the vehicle ABS. Repair the ABS immediately to ensure full braking capability.
	Wheel Spin	Indicates the Automatic Traction Control (ATC) is engaged. Solid illumination indicates a problem with the ATC system. Repair the ATC system immediately to ensure full braking capability.
	High Coolant Temperature	Indicates the coolant temperature is above the maximum allowable temperature listed in **Table 3.2**.

Common Warning and Indicator Lamps		
	Low Air Pressure	Indicates air pressure in the primary or secondary reservoir is below 70 psi (483 kPa).
	Wait To Start	Illuminates when starting the engine during cold conditions. Wait until the lamp goes out before turning the ignition key to START.
	Low Engine Oil Pressure	Indicates the engine oil pressure is below the minimum allowable pressure listed in **Table 3.1**.
	Water In Fuel	Indicates the fuel may contain water. Drain any water collected in the fuel/water separator.
	Fuel Filter Restriction	Indicates the fuel filter is clogged and requires service.
	Low Battery Voltage	Indicates that battery voltage is 11.9 volts or less.
	Check Transmission	Indicates an undesirable transmission condition.
	Transmission Overheat	Indicates high transmission temperature.
	No Charge	Indicates an alternator charge output failure.
	Engine Brake	Indicates the engine brake is engaged.
	Optimized Idle	Indicates optimized idle is enabled.
	Left-Turn Signal	Flashing indicates the outside left-turn signal lights are activated.
	Right-Turn Signal	Flashing indicates the outside right-turn signal lights are activated.
	High-Beam Headlights	Indicates the high-beam headlights are on.

Common Warning and Indicator Lamps		
BRAKE	Parking/Emergency Brake	Indicates the parking brake is engaged.
	Cruise Control	Indicates the cruise control is enabled.
	Unfastened Seat Belt	Activates with an audible alert when the system detects that the parking brake is off and the driver seat belt is not fastened on some vehicles. On other vehicles, this lamp illuminates for 15 seconds when the ignition is first turned on.

Table 3.3, Common Warning and Indicator Lamps

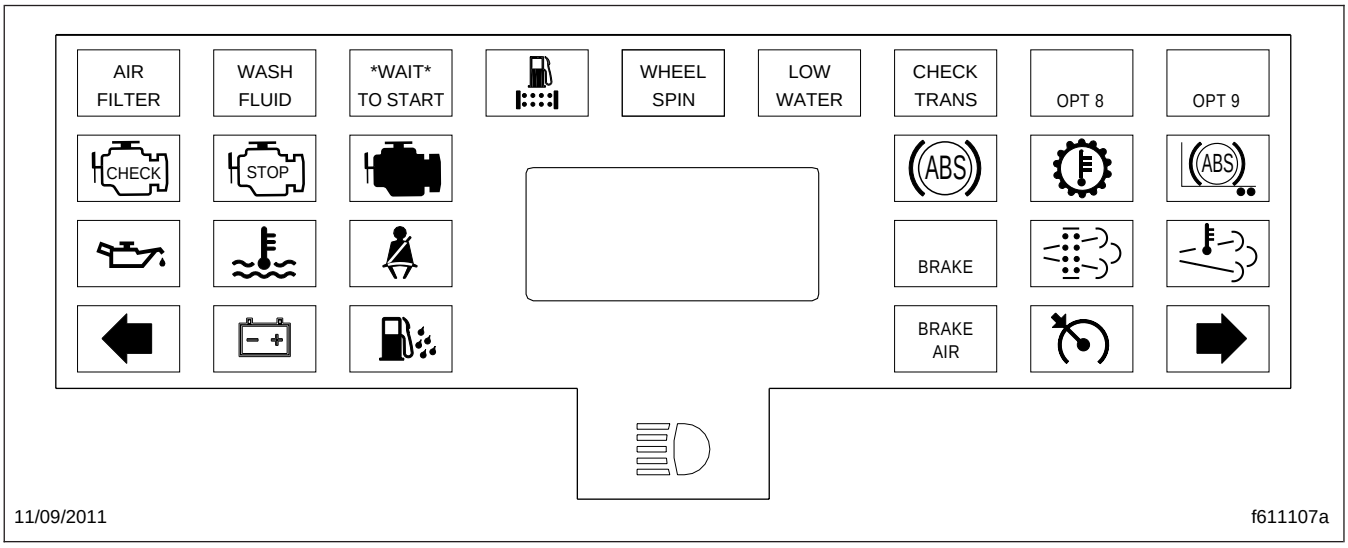


Fig. 3.9, EPA10 Dash Message Center

Standard Instruments

Standard instruments are present on every vehicle. They are listed here in alphabetical order, to make the information easier to find.

Air Pressure Gauges

⚠ WARNING

If air pressure falls below minimum pressure, the braking ability of the vehicle will be limited. Slow the vehicle down and bring it to a gradual stop. Do not attempt to move the vehicle until air pressure has risen above the minimum level. Moving a vehicle without adequate braking power could cause an accident resulting in personal injury or death.

Air pressure gauges, as shown in **Fig. 3.10**, register the pressure in the primary and secondary air systems. The gauges are labeled for the A or B reservoir. Normal pressure with the engine running is 100 to 120 psi (689 to 827 kPa) in both systems.

A low-air-pressure warning light and audible warning, connected to both the primary and secondary systems, activate when air pressure in either system drops below 64 to 76 psi (441 to 524 kPa).

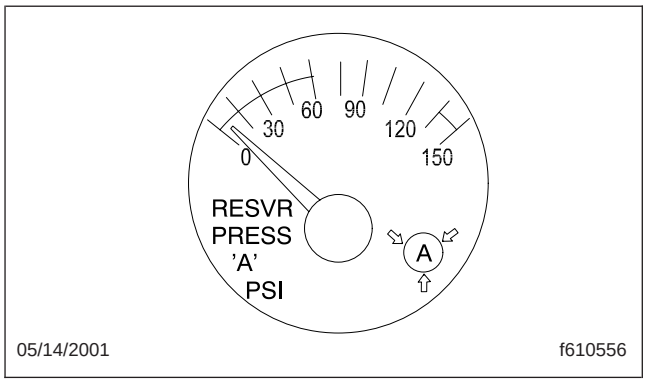


Fig. 3.10, Air Pressure Gauge (reservoir A shown)

When the engine is started, the warning light and audible warning remain on until air pressure in both systems exceeds minimum pressure.

Coolant Temperature Gauge

NOTICE

A sudden increase in coolant temperature may indicate engine or cooling system failure. Bring the vehicle to a safe stop and investigate the cause to prevent further damage. Do not operate the engine until the cause has been determined and corrected.

During normal engine operation, the coolant temperature gauge, as shown in **Fig. 3.11**, should read 175 to 195°F (79 to 91°C). If the temperature remains below 160°F (71°C), inspect the cooling system to determine the cause.

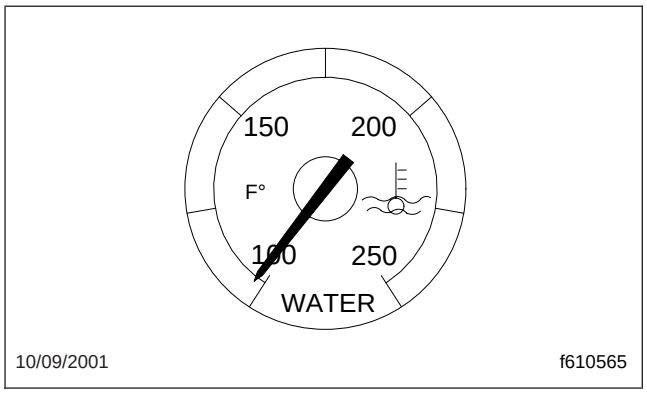


Fig. 3.11, Coolant Temperature Gauge

If coolant temperature rises above the maximum temperature listed in **Table 3.2**, the CHECK engine lamp will illuminate. If the condition does not improve, the STOP engine lamp will also illuminate and an audible warning will sound. The engine will then derate or shut down, depending on the type of engine protection system installed.

Engine Oil Pressure Gauge

NOTICE

A sudden decrease or absence of oil pressure may indicate mechanical failure. Bring the vehicle to a safe stop and investigate the cause to prevent further damage. Do not operate the engine until the cause has been determined and corrected.

The engine oil pressure gauge, as shown in **Fig. 3.12**, displays the current engine oil pressure. If engine oil pressure falls below the minimum levels shown in **Table 3.1**, the CHECK engine lamp will illuminate. If the condition does not improve, the STOP engine lamp will also illuminate and an audible warning will sound. The engine will then derate or shut down, depending on the type of engine protection system installed.

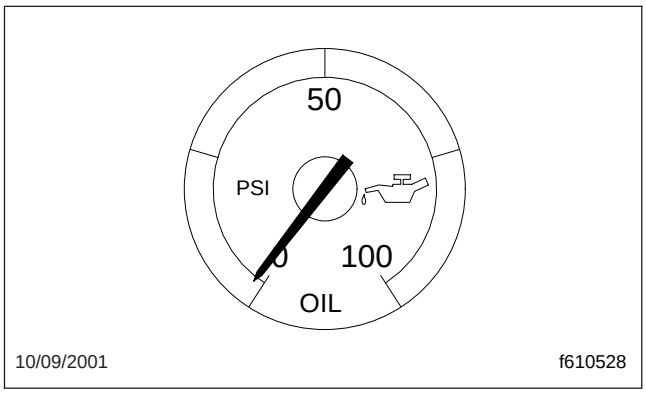


Fig. 3.12, Engine Oil Pressure Gauge

Fuel Gauge, Pre-EPA10

Pre-EPA10-compliant vehicles have a fuel level gauge indicating the level of diesel in the fuel tank(s). See **Fig. 3.13**. A single fuel gauge is standard. If equipped with an optional second fuel gauge, each fuel tank level is indicated on a separate gauge.

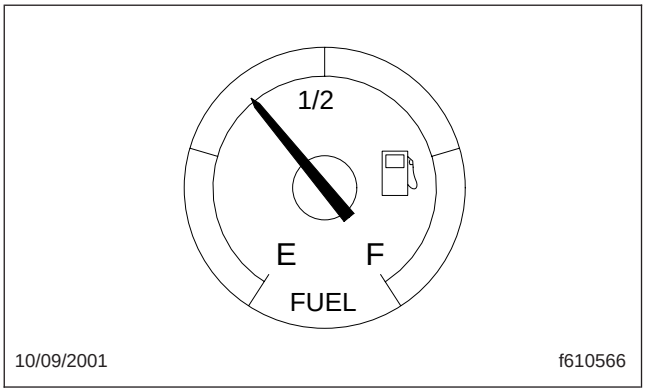
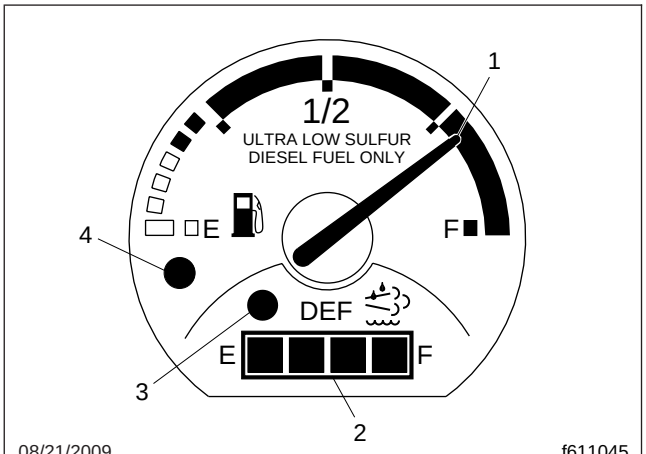


Fig. 3.13, Fuel Level Gauge, Pre-EPA10

Fuel/Diesel Exhaust Fluid (DEF) Gauge, EPA10

For engines that are EPA10-compliant, the fuel and DEF levels are measured in a dual purpose fuel/DEF gauge. See **Fig. 3.14**.

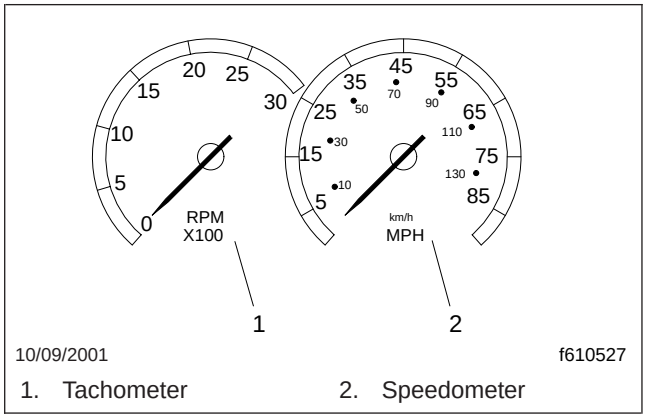


1. Diesel Fuel Level Indicator
2. DEF Level Indicator
3. Low DEF Warning Lamp (amber below 10% DEF)
4. Low Fuel Warning Lamp (amber at 1/8 tank of fuel)

Fig. 3.14, Fuel/DEF Gauge, EPA10

The diesel fuel level is indicated at the top of the gauge, with a low-fuel warning lamp that illuminates when the diesel fuel level registers 1/8th of capacity.

The DEF level is indicated in the lightbar on the lower portion of the gauge. There is a low DEF level warning lamp that illuminates when the DEF level reaches 10% of capacity. See **Chapter 7**for details of the DEF gauge functions.



1. Tachometer
2. Speedometer

Fig. 3.15, Speedometer and Tachometer (U.S. version)

Speedometer

Three speedometer options (see **Fig. 3.15**) are available. The U.S. version of the speedometer registers speed in both miles per hour (mph) and kilometers per hour (km/h), with mph in larger numbers. The metric version of the speedometer face reverses this arrangement, with km/h in larger numbers. The metric-only version shows km/h exclusively.

Voltmeter

The voltmeter is a digital readout located on the bottom line of the dash message center whenever the ignition switch is turned on.

The voltmeter indicates the vehicle charging system voltage when the engine is running and the battery voltage when the engine is off. By monitoring the voltmeter, the driver can stay aware of potential battery charging problems and have them fixed before the batteries discharge enough to create starting difficulties.

The voltmeter will normally show approximately 13.7 to 14.1 volts when the engine is running. The voltage of a fully charged battery is 12.7 to 12.8 volts when the engine is off. Battery voltage under 12.0 volts is considered a low battery, and a completely discharged battery will produce only about 11.0 volts. The voltmeter will indicate lower voltage as the vehicle is being started or when electrical devices in the vehicle are being used.

If the voltmeter shows an undercharged or overcharged condition for an extended period, have the charging system and batteries checked at an authorized Freightliner service facility.

On a vehicle equipped with a battery isolator system, the voltmeter measures the average voltage of all the batteries when the engine is running. When the engine is off, the voltmeter shows only the isolated battery voltage and does not indicate the voltage of the engine-starting batteries.

Optional Instruments

Optional instruments, typically located on the auxiliary dash panel or right-hand control panel, are not found on every vehicle. They are listed here in alphabetical order, to make the information easier to find.

Air Restriction Gauge

The air intake restriction gauge measures the vacuum on the engine side of the air cleaner. On standard installations, it is mounted on the air intake duct in the engine compartment.

As an option for easier viewing, the air intake restriction indicator (see **Fig. 3.16**) can be mounted on the dash, usually on the right-hand control panel.

NOTE: Rain or snow can wet the filter and cause a higher than normal reading temporarily.

Air intake restriction vacuum is measured in inches of water (inH_2O). For vehicles equipped with a graduated indicator or a restriction gauge on the dash, check the gauge with the engine off. If the yellow signal stays locked in the red zone once the engine is shut down, or is at or above the values shown in **Table 3.4**, the air cleaner element needs to be replaced.

Vehicles may be equipped with a go/no-go restriction indicator without graduations (see **Fig. 3.17**) instead of a graduated indicator.

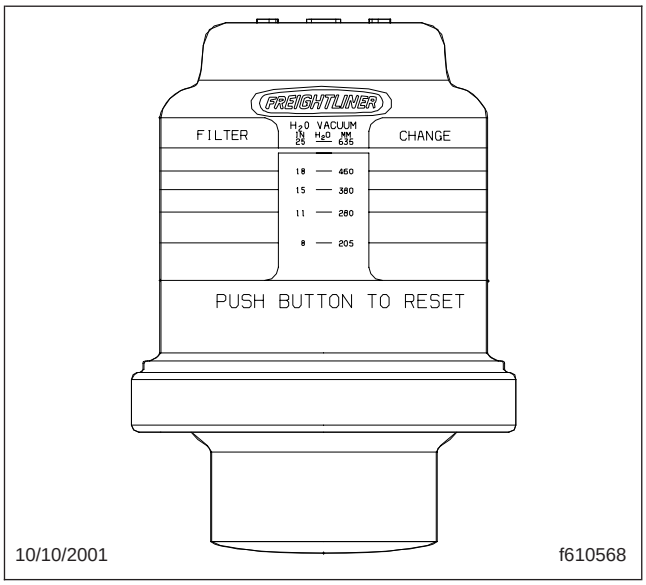


Fig. 3.16, Air Intake Restriction Indicator

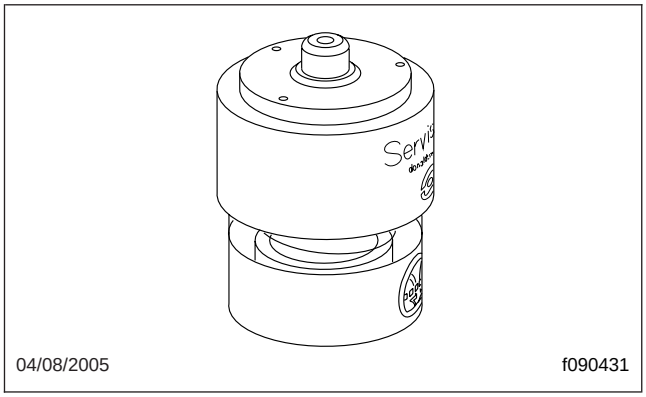


Fig. 3.17, Manual-Reset Air Restriction Indicator, Go/No-Go

Air Intake Maximum Restriction Values		
Engine Make*	**Pre-EPA07 Engines (inH_2O)**	**EPA07/EPA10 Engines (inH_2O)**
Caterpillar	25	—
Cummins	25	25
Detroit Diesel	20	22
Mercedes-Benz	22	22

* Turbocharged engines must be checked at full load and governed engine speed.

Table 3.4, Air Intake Maximum Restriction Values

Ambient Temperature Gauge

The ambient temperature gauge, shown in **Fig. 3.18**, displays the in-cab or outside temperature, depending on the settings selected.

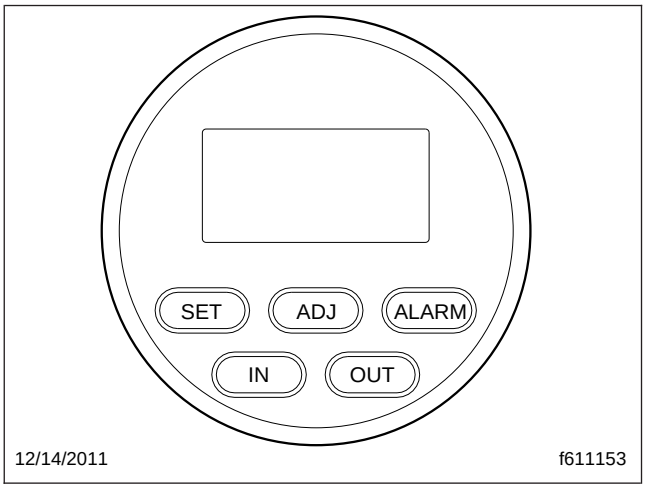


Fig. 3.18, Ambient Temperature Gauge

When the alarm is enabled, the ambient temperature gauge will sound an audible alert and the amber lamp will illuminate when the outside or inside temperature (depending on the setting selected) reaches the set temperature. Turn the alarm on and off using the steps below.

1. Press the IN button for in-cab temperature, or the OUT button for outside temperature.
2. Press the SET button.
3. Press the ADJ button until the desired temperature is displayed.
4. Press the ALARM button and "AL" will appear on the display.
5. Press the SET button to return to the current temperature display.

NOTE: To turn the alarm off, press the ALARM button again and "AL" will disappear from the display.

Ammeter

An ammeter, shown in **Fig. 3.19**, measures current flowing to and from the battery. When the batteries are charging, the meter needle moves to the plus side of the gauge. When the batteries are being discharged, the needle moves to the minus side. A consistent negative reading when the engine is running indicates a possible problem with the charging system.

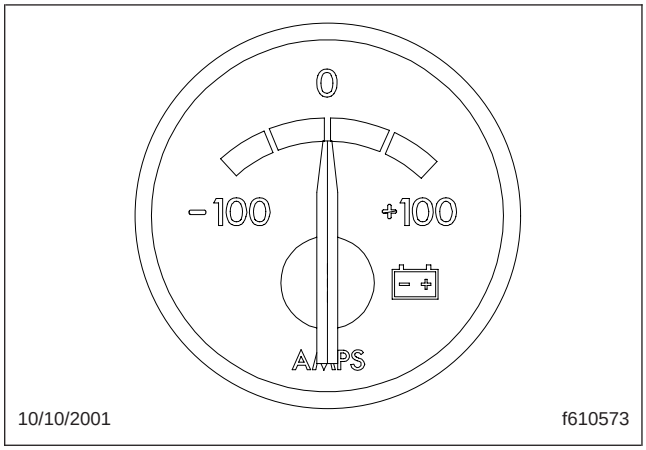


Fig. 3.19, Ammeter

Digital Clock

The digital clock, shown in **Fig. 3.20**, displays the current time, and has a 24-hour alarm with a 3-minute snooze feature.

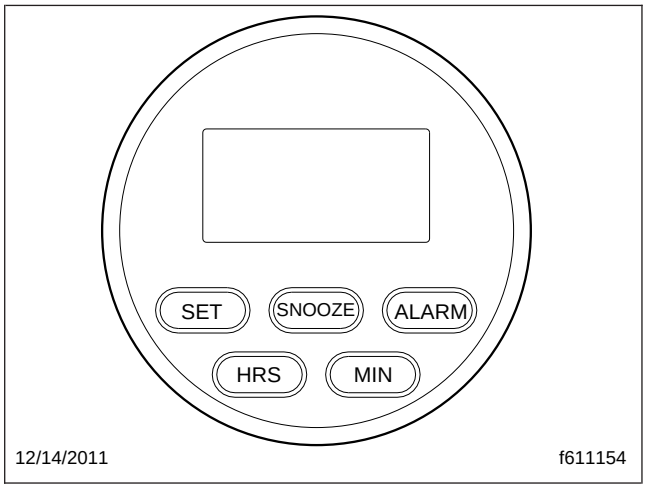


Fig. 3.20, Digital Clock

Set the clock by pressing the SET button, then selecting the desired time by pressing the HRS and MIN buttons. When the clock is set to PM hours, a PM indicator will appear on the display. When the PM indicator is not displayed, the clock is set to an AM hour.

To set the alarm, press the SET button, then press the ALARM button. Select the desired alarm time by pressing the HRS and MIN buttons, then press the SET button once again.

To turn the alarm on and off, press the ALARM button when the current time is displayed. When the alarm sounds, pressing the SNOOZE button will delay the sounding of the alarm for three minutes.

Drive Axle Oil Temperature Gauges

NOTICE

A sudden increase in oil temperature that is not caused by a load increase may indicate mechanical failure. Bring the vehicle to a safe stop and investigate the cause to prevent further damage. Do not operate the vehicle until the cause has been determined and corrected.

During normal operation, forward-rear and rear-rear axle oil temperature gauges (see **Fig. 3.21**) should read between 160 and 220°F (71 and 104°C).

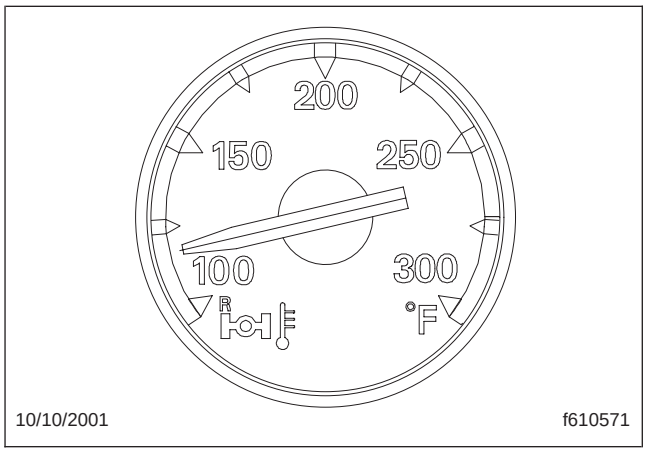


Fig. 3.21, Axle Oil Temperature Gauge

Under heavy loads, such as when climbing steep grades, temperatures that exceed the normal oil temperature range for a short period are not unusual. If the temperature returns to normal when the load decreases, there is no problem.

Engine Oil Temperature Gauge

NOTICE

A sudden increase in oil temperature that is not caused by a load increase may indicate mechanical failure. Bring the vehicle to a safe stop and investigate the cause to prevent further damage. Do not operate the engine until the cause has been determined and corrected.

During normal operation, the optional engine oil temperature gauge (**Fig. 3.22**) should read in the following temperature ranges:

- 160 to 195°F (71 to 91°C) for Caterpillar engines
- 200 to 260°F (93 to 126°C) for Detroit Diesel and Cummins engines
- 177 to 203°F (81 to 95°C) for Mercedes-Benz engines

Under heavy loads, such as when climbing steep grades, temperatures that exceed the normal oil temperature range for a short period are not unusual. If the temperature returns to normal when the load decreases, there is no problem.

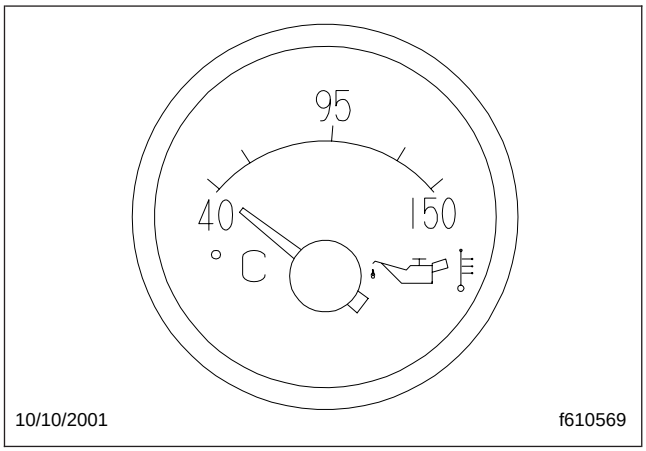


Fig. 3.22, Engine Oil Temperature Gauge

Tachometer

The tachometer, shown in **Fig. 3.9**, indicates engine speed in revolutions per minute (rpm) and serves as a guide for shifting the transmission and keeping the engine in the appropriate rpm range. For low idle and rated rpm, see the engine identification plate.

Transmission Fluid Temperature Gauge

The transmission fluid temperature gauge, shown in **Fig. 3.23**, measures the transmission lubricant operating temperature. Temperatures vary by application, but the transmission fluid temperature gauge reading should not exceed 250°F (121°C).

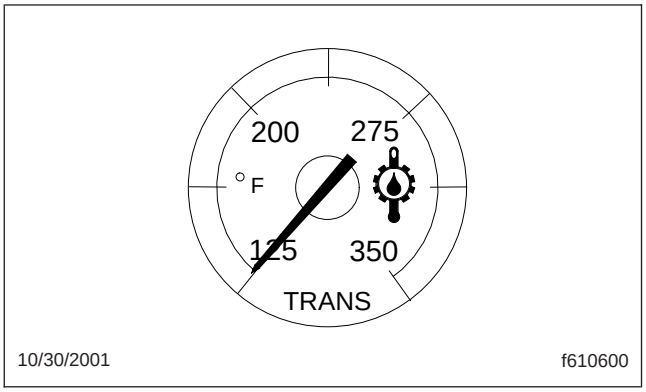


Fig. 3.23, Transmission Fluid Temperature Gauge

NOTICE

A sudden increase in transmission fluid temperature that is not caused by a load increase may indicate mechanical failure. Bring the vehicle to a safe stop and investigate the cause to prevent further damage. Do not operate the vehicle until the cause has been determined and corrected.

Under heavy loads, such as when climbing steep grades, temperatures that exceed the normal oil temperature range for a short period are not unusual. If the temperature returns to normal when the load decreases, there is no problem.

Turbocharger Boost Pressure Gauge

A turbocharger boost pressure gauge, shown in **Fig. 3.24**, measures the pressure in the intake manifold, in excess of atmospheric pressure, being created by the turbocharger.

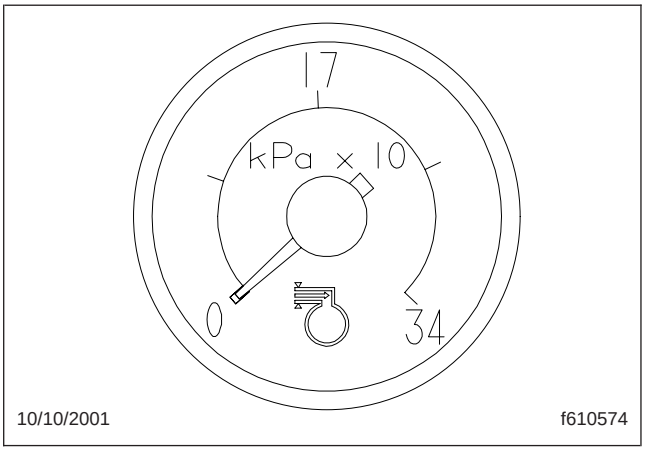
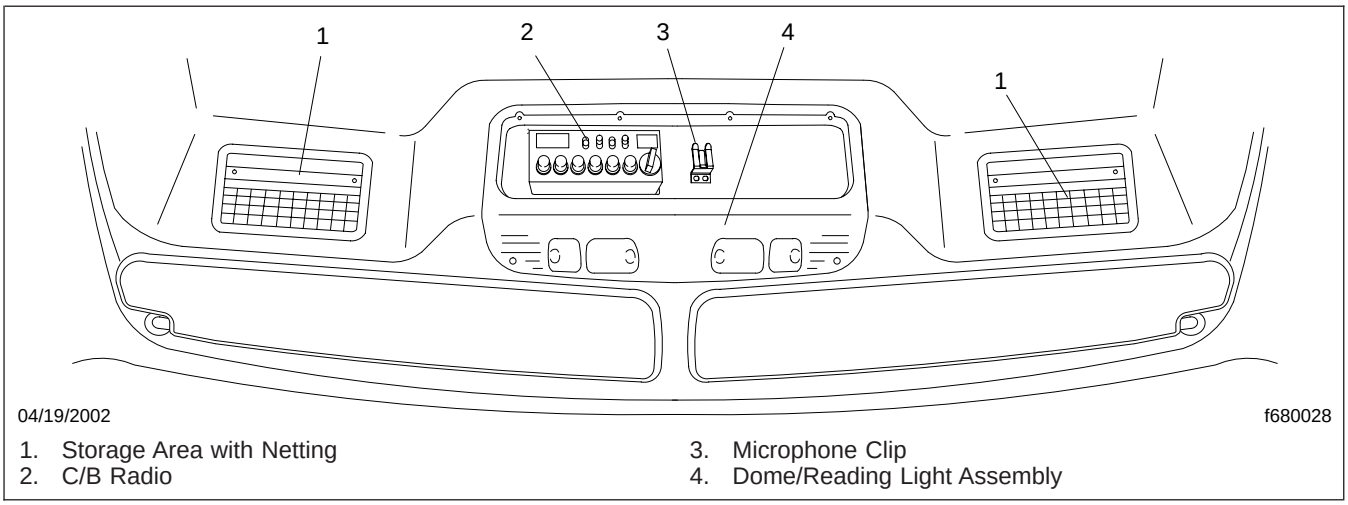


Fig. 3.24, Turbo Boost Pressure Gauge

Overhead Instrument Panel

The optional overhead instrument panel, shown in **Fig. 3.25**, may hold a citizen's band (C/B) radio, a microphone clip, and any switches that can not be accommodated on the driver's or auxiliary dash panels.

The underside of the overhead console also holds the sun visors and the optional dome/reading light assembly. For more information on the dome/reading light assembly, see **Chapter 4**.



1. Storage Area with Netting
2. C/B Radio
3. Microphone Clip
4. Dome/Reading Light Assembly

Fig. 3.25, Overhead Instrument Panel

4

Controls

Ignition Switch and Key 4.1
Electrical System 4.1
Lighting Controls 4.1
Multifunction Turn Signal Switch 4.5
Horn Controls 4.7
Powertrain Controls 4.7
All-Wheel-Drive Controls, Optional 4.11
Braking 4.13
Adjustable Steering Column 4.13
Other Dash-Mounted Controls 4.14
Heater/Air Conditioner Control Panel 4.15
Seat Controls 4.15

Ignition Switch and Key

The ignition switch (**Fig. 4.1**) has four positions: ACCESSORY, OFF, ON, and START. In addition, the same key locks and unlocks the cab doors.

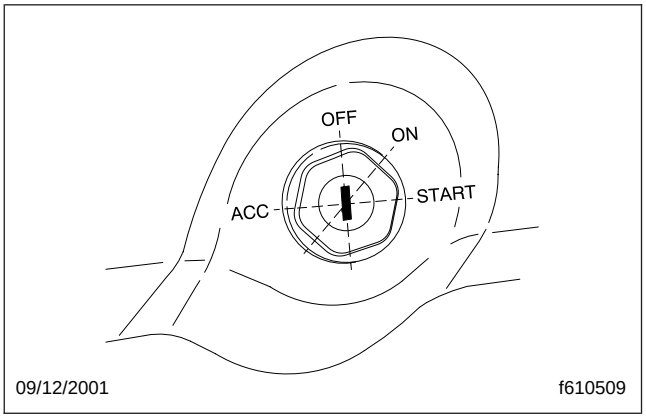


Fig. 4.1, Ignition Switch Positions

In the OFF position, the key slot is vertical; the key can be inserted and removed only in this position. The following can be operated in the off position (regardless of whether the key is inserted): The low-beam headlights, taillights, brake lights, road lights, dome lights, clearance lights, turn signals, hazard warning lights, horn, CB radio, power windows, cigarette lighter, clock, and electric oil pan heater.

In the ACCESSORY position, the key is turned counterclockwise. The radio, stereo system, mirror heat, air dryer, backup lights, and all of the electrical systems that are operable in the off position are operable in the accessory position.

In the ON position, the key is turned clockwise and all electrical systems are operable. The low air pressure and low oil pressure warning lights (or messages) and buzzer operate until the engine is started and pressure is built up.

Electrical System

The Business Class® M2 features a new type of electrical system, different from any previous vehicle. Multiple electrical signals are carried along a simplified set of wires, reducing the size of wiring bundles. There are significantly fewer wires overall, meaning less chance of damage, shorts and other problems.

⚠ WARNING

Do not attempt to modify, add, splice, or remove electrical wiring on this vehicle without authorization from Freightliner Engineering. Doing so could damage the electrical system and result in a fire that could cause serious personal injury or property damage.

There are two new electrical modules, a master module located near the frontwall (bulkhead module) and a slave module located between the frame rails (chassis module).

This new wiring system features intelligent controls that blink to show switch activity and error conditions. These controls cannot be distinguished by their appearance, only by their function.

For more information about these controls, see under the headings "Axle Switches" and "Suspension Dump Switch."

Lighting Controls

The lighting controls mentioned under this heading generally operate through switches located on the dash.

Two types of dash switches are used:

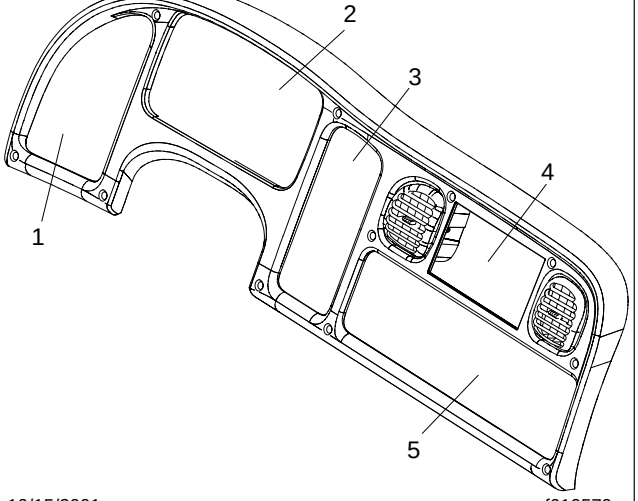
- Paddle switches with a single paddle located in the center of the switch. The paddle can be raised or lowered to perform a function.
- Rocker switches that can be pressed at either the upper or lower end to perform a function. Certain rocker switches are guarded to prevent them from being switched on or off accidentally.

When the panel lights are on, most switch legends are backlit with a colored light, usually green. This allows the driver to find the switch more easily in the dark. When the switch is on, the switch icon is normally backlit with a colored light, usually amber. Some switch icons are dead-fronted (not visible until the switch is turned on). When turned on, some switches are illuminated from within by a red or amber LED (light-emitting diode).

Control Panels

The left-hand control panel (**Fig. 4.2**) contains a louvered window outlet for the face vents of the heating,

ventilation, and air conditioning system (HVAC), and four switches arranged in a vertical line, usually the headlight, panel light increase/decrease, and the cruise control On/Off and Set/Resume switches.



1. Left-Hand Control Panel
2. Instrumentation Control Unit
3. Right-Hand Control Panel
4. Radio Panel
5. Auxiliary Dash Panel

Fig. 4.2, Switch and Gauge Panels

The instrument cluster (ICU3-M2) is located right behind the steering wheel. No controls are installed on the standard instrument cluster.

The right-hand control panel (**Fig. 4.2**) usually contains the transmission push-button shift selector (on vehicles with automatic or automated transmission) and the trailer brake lever (hand control valve). On vehicles with manual transmission, a variety of switches are installed here. If there is a dash-mounted air-restriction indicator, it is often mounted here.

The radio panel contains two louvered dash outlets for the face vents of the HVAC, one on either side of the radio (if installed).

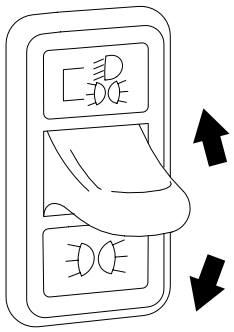
The auxiliary dash panel (**Fig. 4.2**) below the radio panel contains the marker interrupt switch, the air brake valve knobs, the cigarette lighter, and a variety of switch options.

The HVAC climate control panel is on a separate panel below the auxiliary dash panel, between the two cupholders.

Exterior Light Controls

Headlight/Parking Light Switch

The headlight/parking light switch (**Fig. 4.3**) is a paddle switch located on the left-hand control panel above the cruise control switches. When the paddle is lowered, the parking lights illuminate (the front turn signals, the cab marker and identification lights, and the taillights). When the paddle is raised, the low-beam headlights illuminate, along with all the parking lights. To turn off all lights, return the paddle to the center position.



Raise the paddle to illuminate the headlights, low beam.

Lower the paddle to illuminate the parking lights.

Fig. 4.3, Headlight/Parking Light Switch

NOTE: The front turn signal is the amber lens in each headlight unit. The low-beam headlight is the top clear lens in each headlight unit.

When the headlights or parking lights are on, the panel lights also illuminate. An amber light in the switch backlights either the top icon (for headlights and parking lights) or the bottom icon (for parking lights only).

Panel Light Increase/Decrease Switch

When the panel lights are on, they can be either brightened or dimmed by using the INCR/DECR rocker switch just below the headlight switch (**Fig. 4.4**). To brighten the panel lights, press on the upper part of the rocker (at the INCR legend). To dim

the panel lights, press on the lower part of the rocker (at the DECR legend).

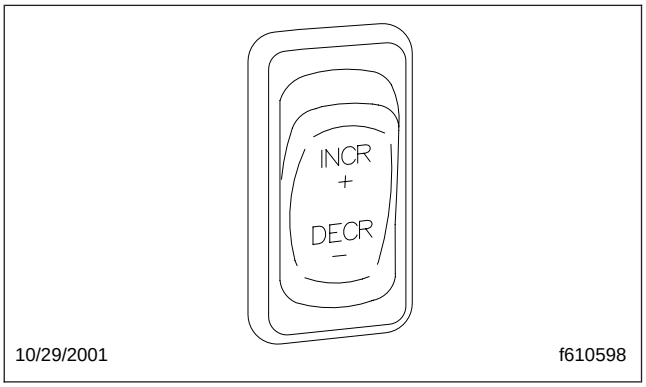


Fig. 4.4, Panel Light Increase/Decrease Switch

When the panel lights are on, both legends are backlit in green.

Daytime Running Lights

Switching on the ignition and releasing the parking brakes automatically activates the daytime running lights, if equipped. The daytime running lights will operate until the parking brakes are applied or the headlights are turned on.

NOTE: Daytime running lights are standard on all Canadian vehicles.

The daytime running lights illuminate at about two-thirds of normal power.

Marker Light Interrupt Switch

The marker light interrupt (MRKR INT) paddle switch temporarily flashes the marker lights and taillights (**Fig. 4.5**). With the vehicle lights on, raise the paddle to briefly turn off the marker lights and taillights. With the vehicle lights off, raise the paddle to briefly turn on the marker lights and taillights.

Turning off the vehicle lights automatically turns off the marker lights. When the panel lights are on, the marker light icon and MRKR INT legend are backlit in green.

Road Light Switch, Optional

The road light (ROAD LAMP) rocker switch operates the optional road lights, which are recessed into the front bumper or mounted on the lower edge of a cut-out in the center of the front bumper.

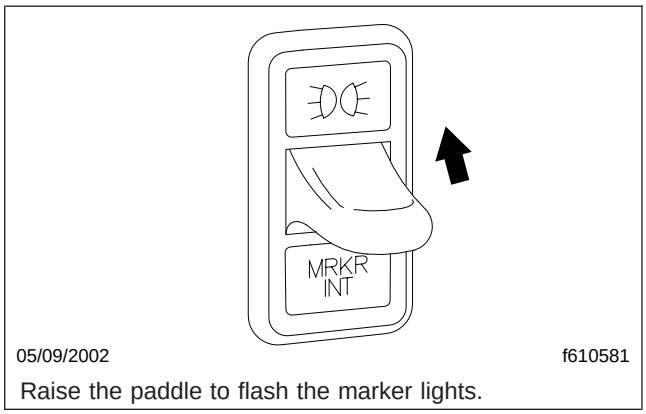


Fig. 4.5, Marker Light Interrupt Switch

The low beam headlights must be turned on before the road lights can be turned on. The road lights will not illuminate if the high beam headlights are already on, and switching from low beams to high beams will switch off the road lights.

To turn the road lights on, press on the upper part of the rocker (at the road light icon). See **Fig. 4.6**. To turn the road lights off, press on the lower part of the rocker (at the ROAD LAMP legend).

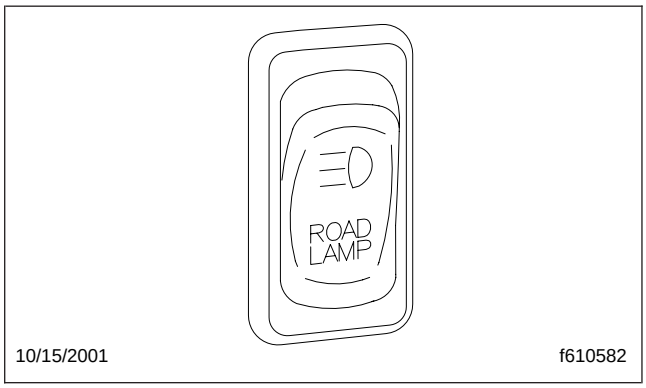


Fig. 4.6, Road Light Switch

When the road lights are on, the road light icon is backlit in amber. When the panel lights are on, the ROAD LAMP legend is backlit in green.

Utility Light Switch, Optional

The utility light switch operates one of the following lights or sets of lights:

- A single round utility light swivel-mounted in the center of the cab roof;

- Two round utility lights mounted in fixed positions on each side of the cab roof;
- Two flush-mounted utility lights mounted on the back of the cab, one on each side.

To turn the utility light(s) on, press in on the upper part of the utility light (UTLY LAMP) rocker switch (**Fig. 4.7**). To turn the utility light(s) off, press on the lower part of the rocker (at the UTLY LAMP legend).

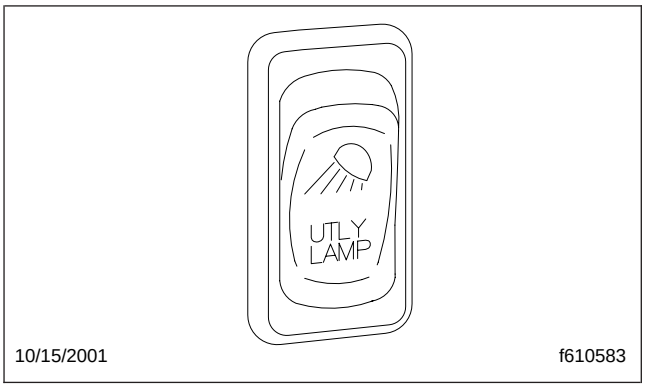


Fig. 4.7, Utility Light Switch

When the utility lights are on, the diagonal light beam icon is backlit in red. When the panel lights are on, the UTLY LAMP legend is backlit in green.

Spotlight, Optional

The spotlight switch is located on the pivoting handle of the spotlight. There may be a single spotlight assembly mounted on the driver's door, or one on each door.

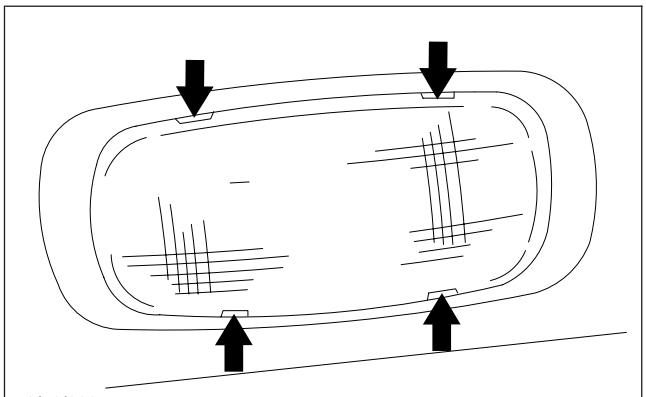
Interior Lights and Light Controls

The interior lights include dome lights, red map lights, and clear reading lights.

Dome Lights

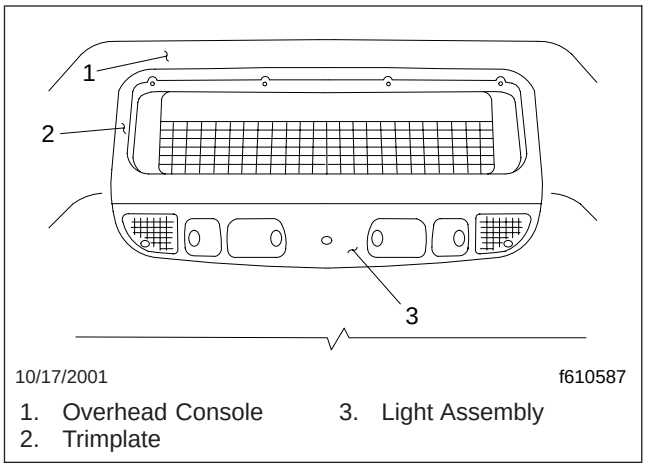
Diffuse dome lights are installed on all cabs. The standard dome light has a clear lens and is installed on the back of the cab above the rear window. See **Fig. 4.8** for the rear dome light.

On cabs with an overhead console, there is an optional overhead dome light assembly containing a diffuse dome and a clear reading light. See **Fig. 4.9** for the optional dome/reading lights on the overhead console.



To remove the lens, press in at the mounting tabs (arrows).

Fig. 4.8, Rear Dome Light



1. Overhead Console
2. Trimplate
3. Light Assembly

Fig. 4.9, Overhead Console Dome Lights

Light Replacement

Rear Dome Light

To replace the rear dome light (**Fig. 4.8**), do the following steps:

1. Press in on the lens at the four mounting tabs (arrows).
2. Replace the bullet-type bulb and install the lens on the lamp base with the button at the bottom.

Overhead Console Dome/Reading Lights

To replace the overhead console dome/reading lights (**Fig. 4.9**), do the following steps:

1. Remove the tapping screws that attach the lamp assembly and trimplate to the overhead console.
2. Separate the lamp assembly from the trimplate and disconnect the wiring harness.
3. Replace the lamp assembly.
4. Snap the lamp assembly and trimplate together.
5. Connect the lamp assembly to the wiring harness.
6. Insert the tabs on the trimplate into the slots on the overhead console attachment plate.
7. Center the lamp assembly in the headliner cutout and install the center tapping screw.
8. Install the remaining tapping screws.

Dome Light Switches

In the standard cab, there is one dome light switch in the driver's door that turns on the diffuse dome light when the driver's door is opened. In one option, two switches are installed, so that the diffuse dome light turns on when either the driver's or passenger's door is opened.

Clear Reading Lights, Optional

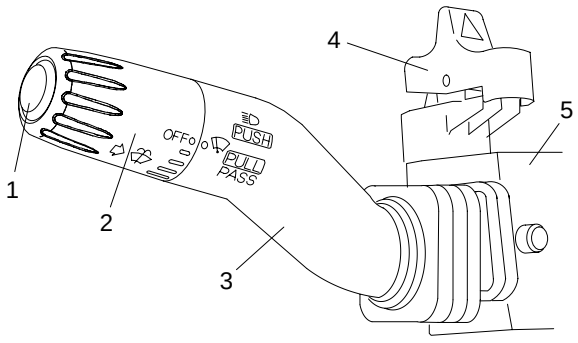
Clear reading lights are available as a option. They are included only in the light assembly installed in the overhead console, located next to the diffuse dome light in the same fixture (**Fig. 4.9**). Like the dome lights, the reading lights are door-activated.

Multifunction Turn Signal Switch

The multifunction turn signal switch is attached to the steering column, just below the steering wheel, on the left-hand side. This switch has the following functions:

- The turn signals
- The windshield wipers and washers
- The headlight high beams
- The hazard warning flasher

See **Fig. 4.10** for the multifunction switch and its component parts.



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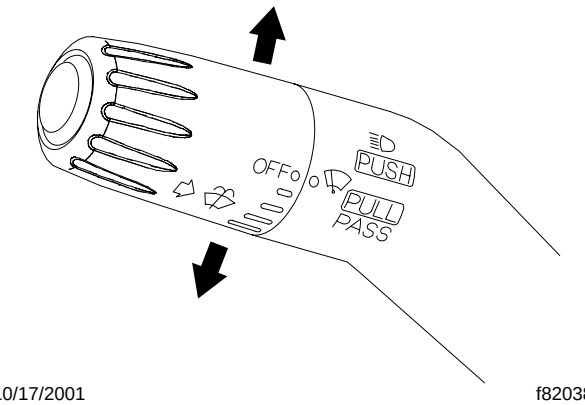
Press down on the upper part of the rocker to activate the hazard warning flashers.

1. Washer Button
2. Wiper Control Dial
3. Turn Signal Lever
4. Hazard Flasher (red rocker switch)
5. Multifunction Switch Module

Fig. 4.10, Multifunction Turn Signal Switch

Turn-Signal Controls

The turn signal lever (**Fig. 4.11**) is mounted on the steering column. Moving the lever down turns on the left turn signal lights; moving it up turns on the right turn signal lights.



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Move the lever down to turn on the left turn signals.

Move the lever up to turn on the right turn signals.

Fig. 4.11, Turn Signal Controls

When one of the turn-signal lights is on, a green indicator arrow flashes at the far left or far right of the warning and indicator light panel.

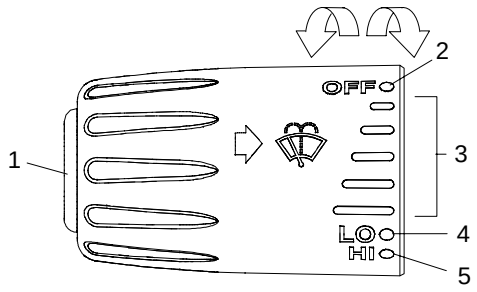
The lever automatically returns to the neutral position (self-cancels the switch) when the steering wheel returns to the straight ahead position after a turn. To cancel the signal manually, move the lever to the neutral position.

Windshield Wiper/Washer Controls

CAUTION

Do not move the wiper arms manually. Wiper motor damage will occur if the arms are moved.

The wipers are operated by a rotary switch in the wiper control dial, which is on the end of the turn signal lever. See **Fig. 4.12**. There are five delay settings, marked on the dial by lines of increasing length, and two steady speed settings, LO and HI.



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Rotate the control dial away from you to turn the wipers on, or speed them up.

Rotate the control dial towards you to slow the wipers down, or turn them off.

1. Washer Button
2. OFF Position
3. Delay Positions
4. Wipers On, Low Speed
5. Wipers On, High Speed

Fig. 4.12, Wiper/Washer Controls

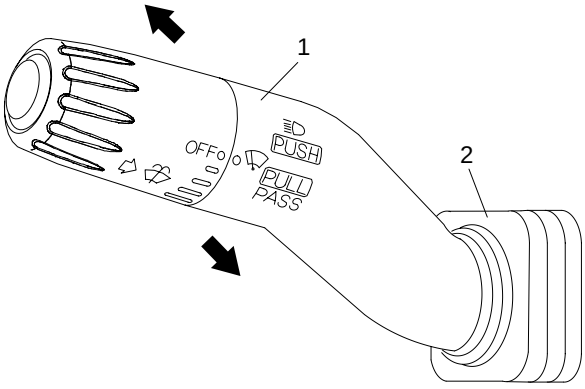
Rotating the control dial forward (in a counterclockwise direction) turns the wipers on. If they are already on, rotating the handle further forward (to a faster speed setting) increases the speed of the wipers through the various delay settings, and to LO and then HI.

Rotating the control dial in the opposite direction (clockwise) causes the wipers to slow down. Rotating the control dial clockwise as far as it will go (to the OFF setting) turns the wipers off.

The washers are operated by a yellow button at the very end of the turn signal lever. To operate the washers, press the button in and hold it in until you want the washers to stop.

Headlight High Beams

Push the turn signal lever forward, towards the windshield, to turn on the high-beam headlights. Pull the turn signal lever back to its original position to turn them off. See **Fig. 4.13**.



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Move the lever away from you to turn on the high beams. Move the lever back to its original position to turn them off.

Move the lever towards you to flash the high beams momentarily.

1. Turn Signal Lever
2. Boot

Fig. 4.13, Headlight High Beams

When the high beam headlights are on, a blue light illuminates on the instrument cluster between the tachometer and speedometer. For vehicles built to operate in the United States, switching on the high beams will switch off the road lights.

NOTE: The ignition switch must be on for the high beams to work.

With the headlight low beams on, pull the lever backward, towards the steering wheel, to flash the high beams (turn them on momentarily).

The headlight low beams remain on continuously during high beam operation. If the low beam headlights are turned off by use of the headlight switch, the high beams turn off also.

Hazard Warning Flasher

The hazard warning light flasher (**Fig. 4.10**) is a red rocker switch located on the top of the multifunction switch module. When the flashers are activated, all of the turn signal lights (front, side, and rear) and the two green indicator arrows on the control panel will blink on and off.

To flash the hazard warning lights, press down on the upper part of the rocker (towards the dash). To stop the hazard warning lights, press down on the lower part of the rocker (towards the steering wheel).

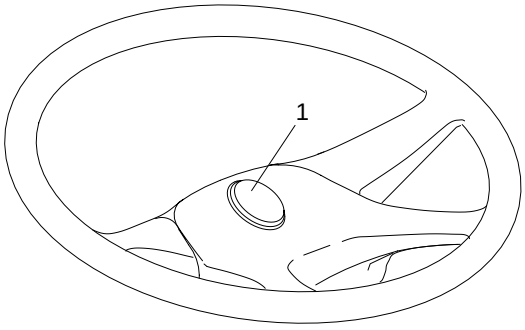
Horn Controls

NOTE: It is possible to have both the electric and the air horn installed on one vehicle.

Electric Horn

A single electric horn is standard. Dual electric horns are available as an option.

The button for the electric horn is located in the center of the steering wheel. To sound the horn, press down on the button. See **Fig. 4.14**.



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To sound the electric horn, press down on the horn button.

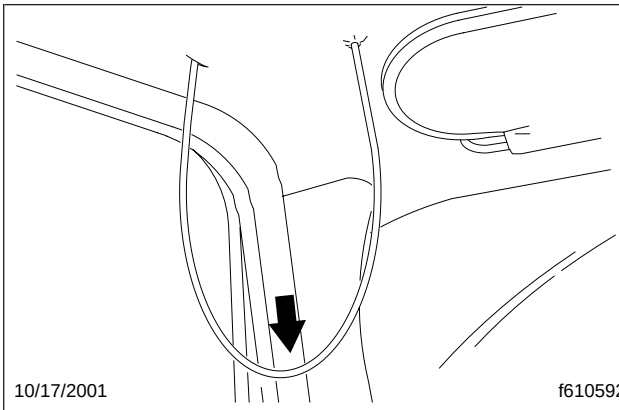
1. Horn Button

Fig. 4.14, Electric Horn Control

Air Horn, Optional

Single and dual air horns are available as options.

The air horn is controlled by a wire lanyard hanging down just inboard on the driver's door. See **Fig. 4.15**. Pull downward on the lanyard to sound the air horn.



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To sound the air horn, pull down on the lanyard (arrow).

Fig. 4.15, Air Horn Control

Powertrain Controls

After-Treatment System (ATS) Request/Inhibit Regen Switch

A parked regen of the ATS can be initiated with the request/inhibit regen switch. It may also be used to inhibit the vehicle from performing an automatic regen. See **Fig. 4.16.**

The style and function of switch will vary with the engine make and model. See the engine operation manual for operation details.

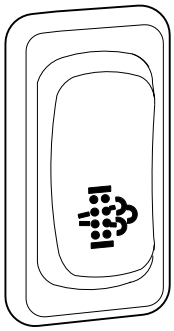

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Fig. 4.16, Request/Inhibit Regen Switch

Cruise Control Switches

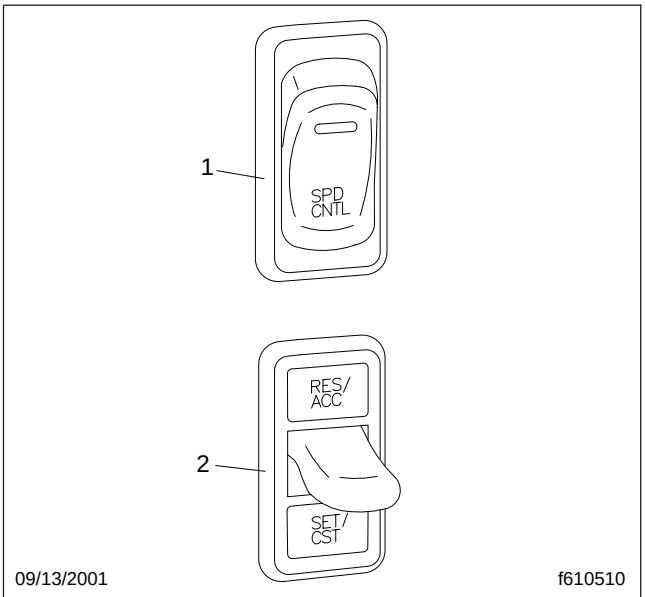
CAUTION

Do not attempt to shift gears without using the clutch pedal when the cruise control is engaged. Failure to follow this precaution will result in a temporarily uncontrolled increase in engine speed; transmission damage and gear stripping could result.

On standard models, cruise control is activated by two dash switches. See **Fig. 4.17**. On some models, cruise control can be activated by a button on the transmission shift knob.

- The On/Off Switch—this two-position rocker switch bears the legend SPD CNTL on the lower half of the switch. When cruise control is on, an amber light illuminates in the top part of the switch.
- The Set/Resume Switch—this three-position paddle switch bears the legend RES/ACC above the paddle and SET/CST below the paddle.

NOTE: For more information about cruise control operation, see **Chapter 7**.



To turn cruise control on, press the upper half of the On/Off (rocker) switch. To turn cruise control off, press the lower half of the On/Off (rocker) switch.

1. Cruise Control On/Off (rocker) Switch
2. Cruise Control Set/Resume (paddle) Switch

Fig. 4.17, Cruise Control Switches, Dash-Mounted

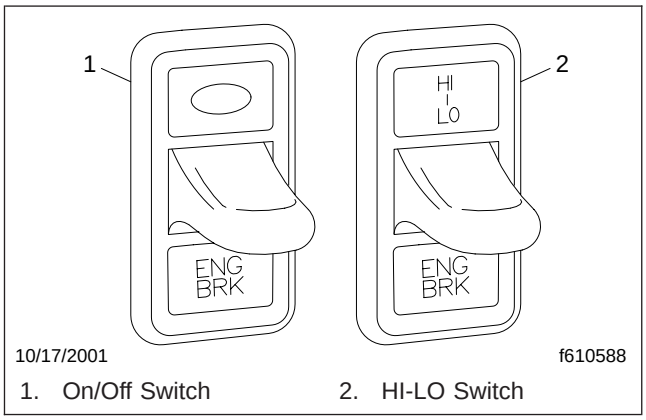
Engine Brake Switch, Optional

The engine brake switch controls the degree of engine braking. Normally there are two paddle switches, a two-position On/Off Switch to activate the engine brake, and a two-position HI-LO Switch to control the amount of engine braking.

To turn the two-position On/Off Switch on, raise the paddle. When the two-position switch is on, an amber LED (light-emitting diode) illuminates inside the switch.

To turn the two-position HI-LO Switch on high, raise the paddle (at the HI-LO icon). To turn the two-position HI-LO Switch on low, lower the paddle (at the ENG BRK legend). See **Fig. 4.18**.

A three-position switch is used on MBE900 engines equipped with both the regular engine brake and the constant-throttle (decompression) brake. It works the same as the two-position HI-LO switch, except that there is a third (off) position when the switch is left at its normal position.



1. On/Off Switch
2. HI-LO Switch

Fig. 4.18, Engine Brake Switches

The engine brake turns off automatically or when the clutch pedal is pressed. On vehicles without a clutch pedal, the brake pedal can be used to deactivate the engine brake. For more information about engine brake operation, see **Chapter 7**.

When the panel lights are on, the HI-LO icon is backlit in amber on the HI-LO switch. On both switches,

the ENG BRK legend is backlit in green when the panel lights are on.

Exhaust Brake Switch, Optional

The optional exhaust brake is controlled by a dash-mounted rocker switch to help slow the vehicle when the accelerator is released. See **Chapter 7** under the heading "Exhaust Braking System, Optional" for additional information.

To turn the exhaust brake on, press on the upper part of the rocker (at the light inside the switch). The exhaust brake turns off automatically. See **Fig. 4.19** or **Fig. 4.20**.

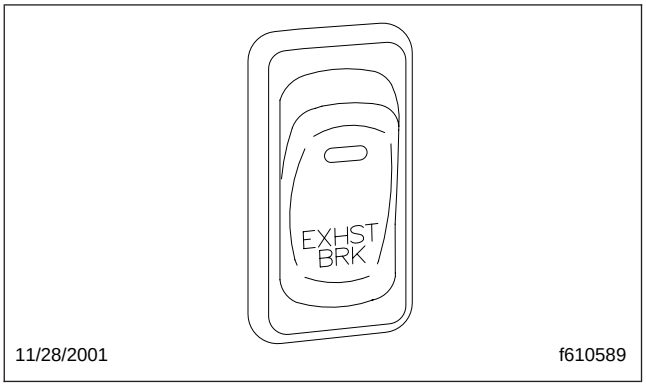


Fig. 4.19, Exhaust Brake Switch

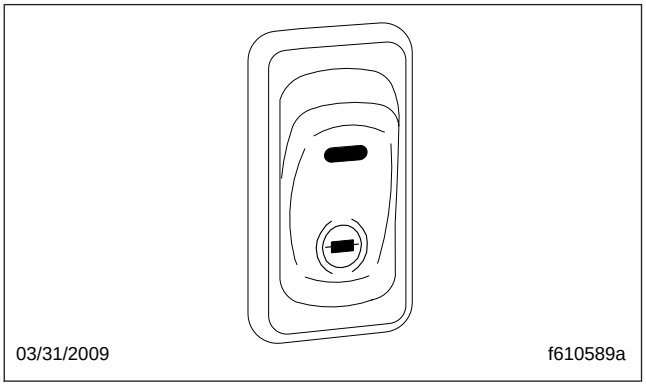


Fig. 4.20, Exhaust Brake Switch

When the exhaust brake switch is on, an amber LED illuminates inside the switch. When the panel lights are on, the EXHST BRK legend is backlit in green.

Engine Fan Switch, Optional

The engine cooling fan can be turned on by the engine fan switch (ENG FAN legend). The fan will continue to operate for a set amount of time and then turn off unless the coolant temperature is high enough to continue the fan operation.

To turn the engine fan on, press on the upper part of the rocker (at the fan icon). See **Fig. 4.21**.

When the engine fan is running, the fan blade icon is backlit in amber. When the panel lights are on, the ENG FAN legend is backlit in green.

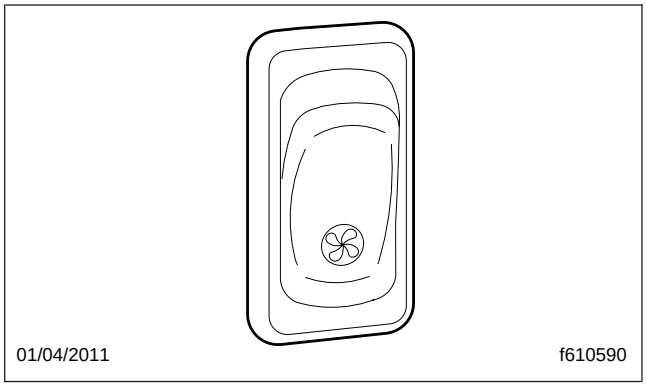


Fig. 4.21, Engine Fan Switch

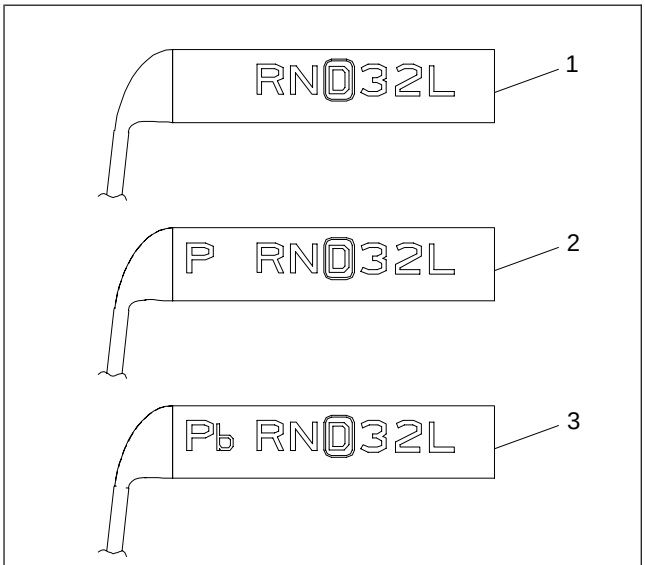
Transmission Controls

If so equipped, the transmission range control valve and splitter valve are attached to the gearshift knob. Transmission shift pattern labels are located inside the cab. See **Chapter 8** for complete transmission operating instructions.

On vehicles with standard Allison On-Highway Series automatic transmission, the shift selector is lever-activated. The display mounted on the steering column provides four forward ranges and one reverse range. See **Fig. 4.22**.

When the transmission is in D (drive), the vehicle will operate in the overdrive (5th) gear. To shift down into the direct drive (4th) gear, use the overdrive lockout switch (O/D legend). See **Fig. 4.23**. The transmission will shift into 4th gear and remain in that gear unless a range inhibitor is active, such as engine overspeed. See **Chapter 8** for more information about range inhibitors.

To shift to fourth gear, press on the upper part of the rocker (at the LED). The LED will come on and stay



1. All Series, Standard (without park)
2. 1000/2400 Series, Optional (with park)
3. 2000 Series, Optional (with auto-apply parking brake)

Fig. 4.22, Steering Column-Mounted Shift Controls

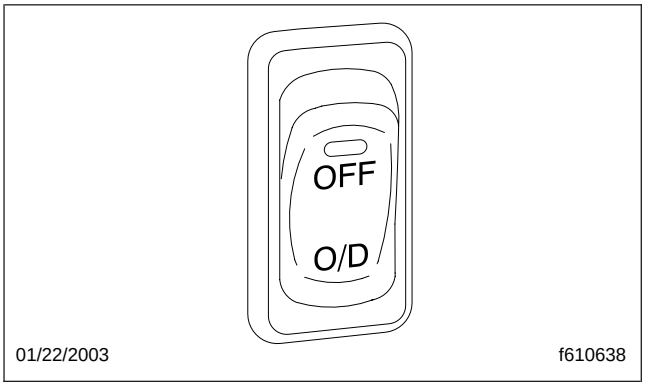


Fig. 4.23, Overdrive Lockout Switch

illuminated until the bottom part of the rocker switch is pressed.

On vehicles with Allison MD Series automatic transmission or Eaton Autoshift automated transmission, a push-button shift selector provides four, five, or six forward ranges and one reverse range. See **Chapter 8** for more information about the push-button shift selector.

Axle Switches

All axle switches contain a red LED (light-emitting diode) that illuminates the switch from within when the switch is turned on (the upper part of the rocker is pressed). The legend under the LED, if any, is not visible until the switch is turned on.

IMPORTANT: A guard is positioned around all axle switches to prevent unintentional activation.

NOTE: For more information on axle switch function, see **Chapter 8**.

Differential Lock Switch

CAUTION

Differential lock should only be engaged when the vehicle is stopped or moving slowly at low throttle. This will prevent internal axle damage.

The differential lock switch is a two-position guarded rocker switch. See **Fig. 4.24**. It causes the wheels on each axle governed by the switch to rotate together. It is also known as side-to-side wheel lock.

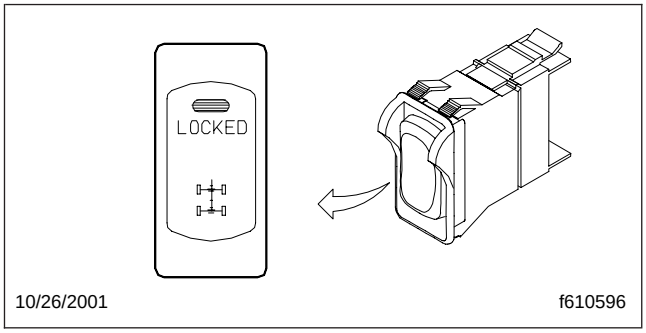


Fig. 4.24, Differential Lock Switch

To lock the wheels together, press the upper half of the rocker momentarily (at the LED). To turn off differential lock, press the upper half of the rocker again.

When the panel lights are on, the double-axle icon is backlit in green.

IMPORTANT: The differential lock switch is guarded to prevent unintentional switch activation. If the LED in the switch begins to blink during normal operation, when the switch has not been activated, this indicates an error condition.

Bring the vehicle to an authorized Freightliner service facility as soon as possible.

Interaxle Lock Switch

CAUTION

The interaxle lock should not be engaged on a vehicle with obviously spinning wheels. Engagement at high speed or power can damage the axle(s).

The interaxle lock switch is a two-position guarded rocker switch installed on vehicles with dual drive axles. See **Fig. 4.25**. It causes both axle shafts to rotate together.

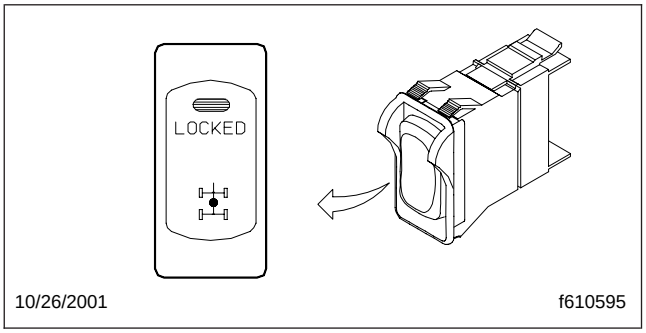


Fig. 4.25, Interaxle Lock Switch

To lock the axles together, press the upper half of the rocker momentarily (at the LED). To turn off interaxle lock, press the upper half of the rocker again.

When the panel lights are on, the double-axle icon is backlit in green.

IMPORTANT: The interaxle lock rocker switch is guarded to prevent unintentional switch activation. This switch does not have a diagnostic blink function when inactive.

Axle Shift Switch

CAUTION

To prevent transmission and axle damage, make sure the automatic transmission is in high range when performing an axle shift with the vehicle moving.

The axle shift switch is a two-position guarded rocker switch installed on vehicles with two-speed axles. See **Fig. 4.26**.

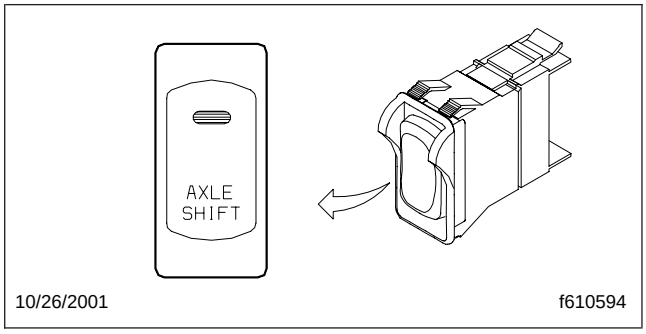


Fig. 4.26, Axle Shift Switch

To shift the axle from low speed to high speed, press the upper half of the rocker momentarily (at the LED). To turn the axle shift off (switch from high speed back to low speed), press the upper half of the rocker again.

NOTE: On vehicles with tandem drive axles, there is an interlock that prevents a 2-speed axle from shifting whenever the interaxle lock is on.

When the panel lights are on, the AXLE SHIFT legend is backlit in green.

IMPORTANT: The axle shift switch is guarded to prevent unintentional switch activation. If the LED in the switch begins to blink during normal operation, when the switch has not been activated, this indicates an error condition. Bring the vehicle to an authorized Freightliner service facility as soon as possible.

All-Wheel-Drive Controls, Optional

All-wheel-drive (AWD) allows the driver to direct driveline power to all four axles, front and rear. Two switches are used to control AWD: an AWD operation switch used to activate all-wheel-drive, and an AWD range switch used to select the high or low range. AWD controls are not multiplexed.

AWD Operation Switch

The AWD operation switch is a two-position rocker switch with a light-emitting diode (LED) that illuminates when AWD is engaged. The legend LOCKED is underneath the LED on the upper half of the switch. On the lower half is the legend AWD. See **Fig. 4.27**. When the panel lights are on, the AWD legend is backlit in green.

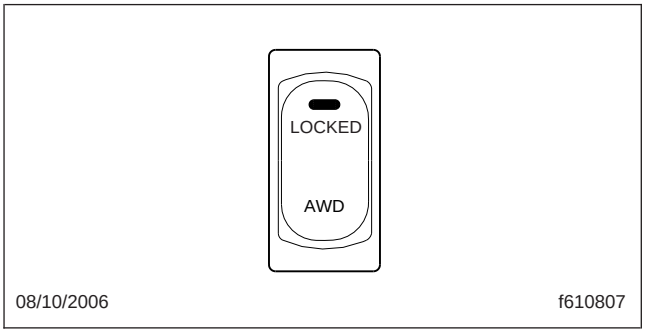


Fig. 4.27, AWD Operation Switch

To engage AWD, press the upper half of the rocker switch. The LED illuminates to indicate that AWD is engaged. To turn off AWD, press the lower half of the switch. The LED goes out to indicate the AWD is no longer engaged.

When AWD is engaged, the LOCKED legend is backlit in red. In addition, a red indicator with the legend T-CASE ENGAGED displays on the dash message center.

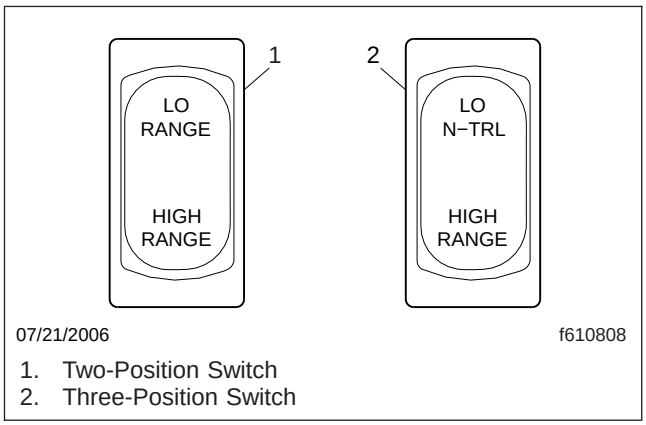
AWD Range Switch

CAUTION

To prevent damage to the transfer case and the driveline, stop the vehicle and apply the parking brake before using the range switch.

The AWD range switch is used under similar conditions to those of the axle shift switch on a two-speed rear axle. Use the high range when driving at normal speeds under off-road conditions, or on non-paved surfaces. Use the low range when extra traction is needed at lower speeds; for example, under conditions of mud, snow, or ice. This switch should be used only when AWD has been engaged.

In most cases, the AWD range switch is a two-position rocker switch with the legends LO RANGE at the upper end and HIGH RANGE at the lower end. On vehicles with a power take-off unit (PTO), the three-position switch has a neutral (N-TRL) position in the middle. See **Fig. 4.28**. When the panel lights are on, the HIGH RANGE legend is backlit in green.



1. Two-Position Switch
2. Three-Position Switch

Fig. 4.28, AWD Range Switches

Two-Position Switch (no PTO)

On vehicles without a PTO, high range is considered standard operation. To activate the low range, press the upper half of the switch. When the low range is activated, the LO RANGE legend is backlit in red. In addition, a red indicator with the legend T-CASE LO RNG displays on the dash message center. To switch back to HIGH RANGE, press the lower half of the switch.

Three-Position Switch (with PTO)

IMPORTANT: Always use the N-TRL switch position when operating the PTO.

On vehicles with a PTO, neutral is considered standard operation (switch in the middle position). An amber indicator with the legend T-CASE NTRL displays on the dash message center.

To activate the high range, press the lower half of the switch. No indicator displays on the dash message center with the high range activated. Press the upper half to return to N-TRL.

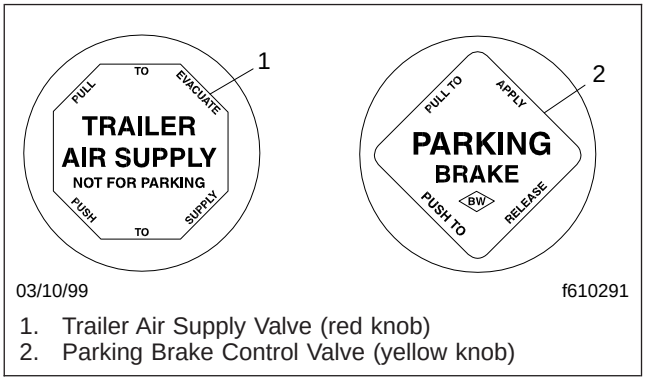
To activate the low range, press the upper half of the switch. A red indicator with the legend T-CASE LO RNG displays on the dash message center. On the switch, the LO N-TRL legend is backlit in red. Press

the lower half to return to N-TRL, and then press the lower half again to select HIGH RANGE.

Braking

Parking Brake Control Valve

The yellow diamond-shaped knob (**Fig. 4.29**) on the auxiliary dash panel operates the parking brake control valve (park brake switch). Pulling the yellow knob applies the tractor parking brakes (spring brakes). Pushing in the knob releases the tractor parking brakes. Before the parking brakes can be released, the air pressure in either air brake system must be at least 65 psi (448 kPa).



1. Trailer Air Supply Valve (red knob)
2. Parking Brake Control Valve (yellow knob)

Fig. 4.29, Brake Valve Control Knobs

See **Chapter 9** under the heading "Dual Air Brake System" for further information about the parking brake control valve.

Trailer Air Supply Valve

The red octagonal-shaped knob (**Fig. 4.29**) on the auxiliary dash panel operates the trailer air supply valve. After the vehicle and its air hoses are connected to a trailer, and the pressure in the air system is at least 65 psi (448 kPa), the red knob must be pushed in (and should stay in) to charge the trailer air supply system and release the trailer spring parking brakes. Before disconnecting a trailer or when operating a vehicle without a trailer, the red knob must be pulled out.

See **Chapter 9** under the heading "Dual Air Brake System" for further information about the trailer air supply valve.

Trailer Brake Lever

The trailer brake lever (hand control valve) is used for applying the trailer brakes without applying the truck or tractor brakes. It is usually mounted on the right-hand control panel. See **Fig. 4.30**. See **Chapter 9** under the heading "Dual Air Brake System" for operating instructions.

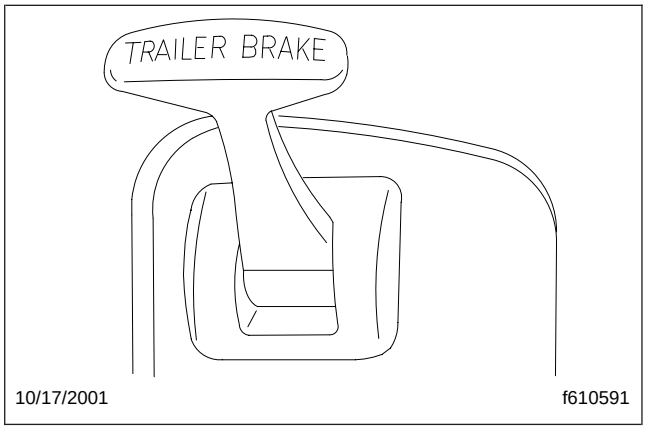


Fig. 4.30, Trailer Brake Lever

Meritor™ WABCO® Antilock Braking System (ABS)

The Meritor WABCO Antilock Braking System (ABS) has an amber tractor indicator light (TRACTOR ABS legend) and, if equipped with automatic traction control (ATC), an amber wheel spin indicator light (WHEEL SPIN legend). See **Fig. 4.31**.

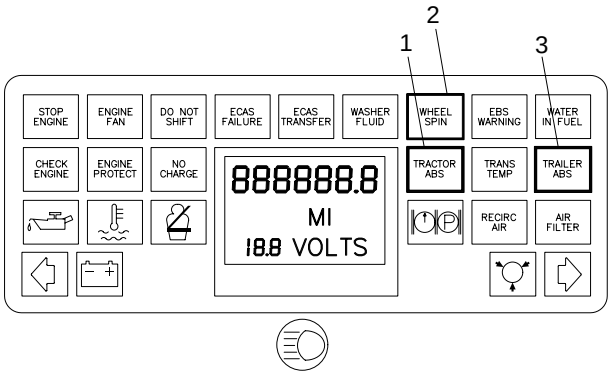
On vehicles equipped with a compatible trailer, there is also an amber trailer indicator light (TRAILER ABS legend).

See the brake system operating instructions in **Chapter 9** for more information about ABS.

Adjustable Steering Column

To tilt the steering column, press down on the foot pedal located below the steering column. Tilt the steering column up or down to the desired position. Release the foot pedal to lock the steering column in place. See **Fig. 4.32**.

To telescope the steering column, press down on the foot pedal located below the steering column. Pull the steering wheel closer to you or push the steering



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1. Tractor ABS Indicator
2. Wheel Spin Indicator (optional)
3. Trailer ABS Indicator

Fig. 4.31, ABS Indicator Lights

wheel farther away from you. Release the foot pedal to lock the steering column in place.

Other Dash-Mounted Controls

Windshield-Fan Switches, Optional

Ceiling-mounted defogger fans are operated by LOW/OFF/HIGH toggle switches located in the base of the fan.

Cigarette Lighter

Push in the lighter to heat the element. The lighter will stay in and will automatically pop out when the element is hot.

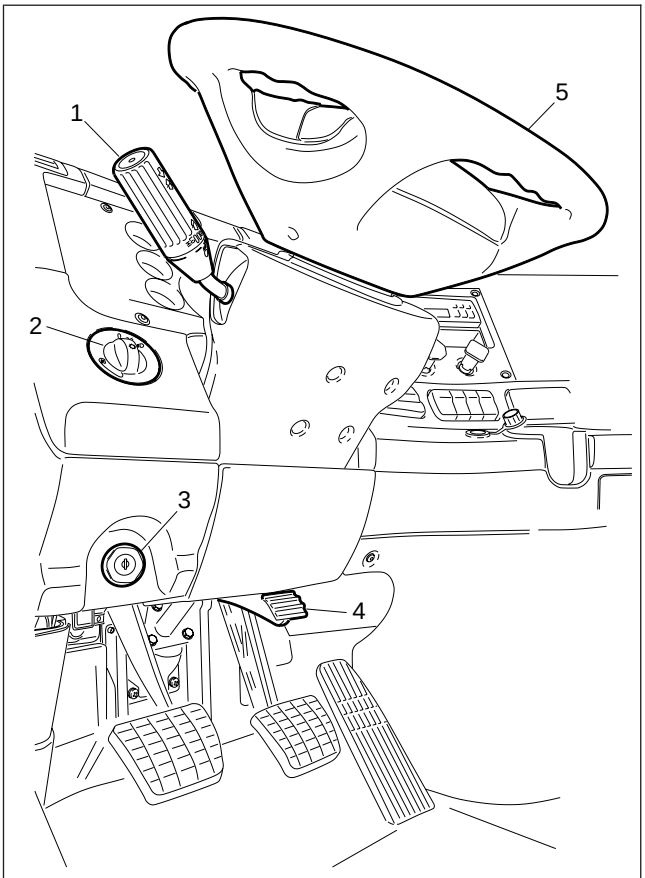
CB Radio Connections

An antenna connection and positive (+) and negative (–) power connections are provided for a CB radio.

Suspension Dump Switch

NOTICE

Do not operate the vehicle over uneven ground such as ramps, speed bumps, curbs, etc. with the air springs deflated. Doing this may lead to air bag separation from the piston, preventing the suspension air springs from reinflating.



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1. Multifunction Turn Signal Switch
2. Headlight Switch
3. Ignition Switch
4. Adjustable Steering Column foot Pedal
5. Steering Wheel

Fig. 4.32, Adjustable Steering Column

NOTICE

Never exhaust air from the suspension while driving. When the air is exhausted, the suspension will not absorb road shocks, and components may be damaged.

The suspension dump switch is a two-position guarded rocker switch (**Fig. 4.33**). It allows the air in the vehicle air suspension to be quickly exhausted, lowering the rear of the vehicle. This makes it easier to connect to, or disconnect from, a trailer.

To lower the rear of the vehicle quickly, press the upper half of the rocker momentarily (at the LED). To

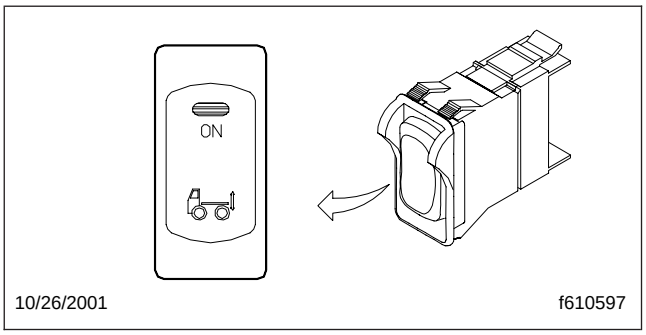


Fig. 4.33, Suspension Dump Switch

raise the suspension to its normal height, press the upper half of the rocker again.

When the panel lights are on, the tractor icon is backlit in green.

IMPORTANT: The suspension dump switch is guarded to prevent unintentional switch activation. This switch does not have a diagnostic blink function when inactive.

When the suspension dump switch is pressed, three responses are possible: a normal response, a slow response, and an abnormal response.

Normal Response: The LED in the switch blinks while the suspension is deflating or filling. When it is completely deflated, the LED comes on steady and stays illuminated. In normal operation, the suspension may dump or fill so quickly that the blinking of the switch is barely noticeable.

If operation of the switch is not possible for any reason (vehicle is moving faster than 5 mph, ignition is turned off, etc.), the LED will stop blinking and turn off.

Slow Response: If operation of the switch is slowed for any reason (by cold weather, low air pressure, etc.), the switch will continue to blink until the suspension completes a dump or fill. As in the normal response, the LED comes on steady and stays illuminated when the suspension if fully deflated.

Abnormal Response: If the LED blinks for more than 10 seconds, the suspension dump mechanism may not be operating properly. Bring the vehicle to an authorized Freightliner service facility for testing.

If the ignition is turned off while the vehicle is in dump mode, the power to the dump solenoid is cut off to prevent battery drain, and the suspension system will autofill the rear air springs. The suspension will also autofill if the vehicle is operated with the suspension dumped, and the speed is over 5 mph (e.g. -- driver forgot to inflate the bags or there was a system failure).

Suspension Autofill Override Valve

The suspension autofill override option is a dash air valve, that keeps the suspension deflated when the ignition is turned off. To operate it, turn off the ignition then push the override valve knob. See **Fig. 4.34**. When the ignition is turned on, the override valve will release automatically, and the suspension will autofill. The suspension dump switch will then operate normally as described previously.

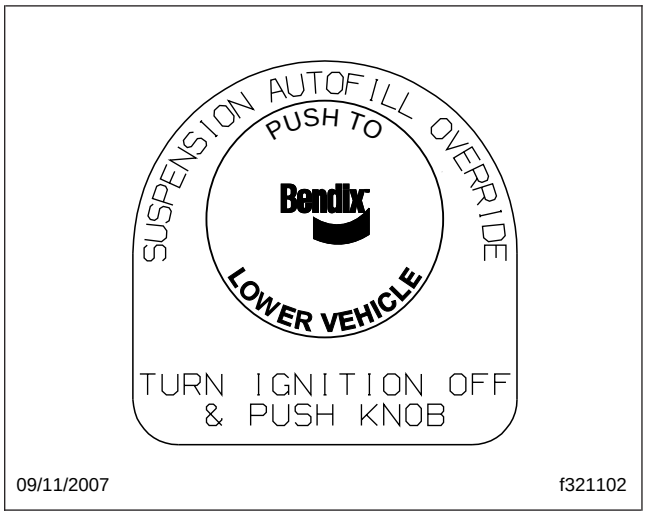


Fig. 4.34, Suspension Autofill Override Valve

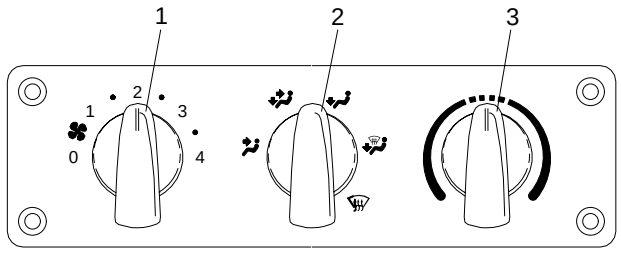
Heater/Air Conditioner Control Panel

Standard controls (**Fig. 4.35**) for the heating, ventilation, and air-conditioning system (HVAC) consist of an eight-speed fan switch, an air selection switch, and a temperature control switch. On vehicles with air conditioning, the panel also contains a telltale LED and an air recirculation button. See **Chapter 6** for detailed operating instructions for the HVAC.

Seat Controls

Bench Seat Adjustment Controls

The standard bench seat has one control: the seat slide lever. See **Fig. 4.36**. The two-person bench



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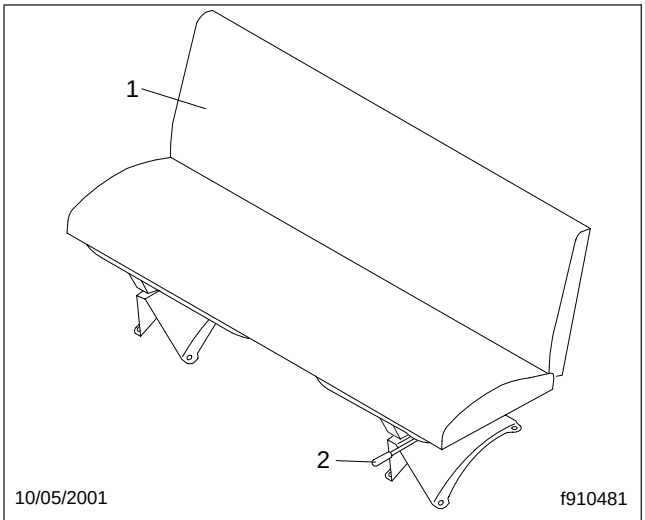
1. Fan Switch
2. Air Selection Switch
3. Temperature Control Switch

Fig. 4.35, HVAC Climate Control Panel, Standard

seat and the non-suspended passenger seat have no controls.



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1. Three-Person Seat
2. Seat Slide Lever

Fig. 4.36, Full Bench Seat

Suspension Seat Adjustment Controls

All controls for adjusting air suspension seats are located within easy reach of the occupant.

Due to the maximum adjustability of mid- and high-back air suspension seats, it is possible to combine the seat back recline adjustment and the seat slide adjustment so that the seat back contacts the backwall. It is the responsibility of the driver to adjust the seat to prevent damage to the seat and the cab interior.

All adjustment controls for a suspension seat are located on the seat base. See **Chapter 5** for complete instructions.

5

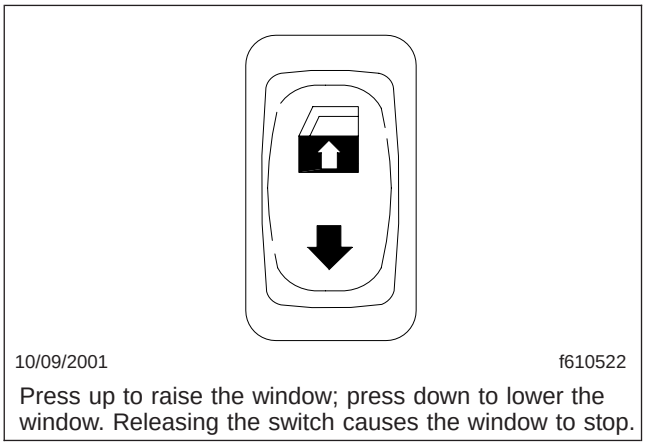
Cab Features

Windows 5.1
Mirrors 5.1
Seats 5.2
Seat Belts and Tether Belts 5.7
Air Bag, Optional 5.9
Cab Amenities 5.10
Windshield Washer Reservoir 5.11

Windows

Standard windows operate mechanically using a hand crank.

Power windows are optional, and can be installed on one side or both sides. One power window switch (window icon) will be installed on the dash for each window. See **Fig. 5.1**. If your vehicle is equipped with power windows, press up to raise the window; press down to lower the window. Releasing the switch causes the window to stop.



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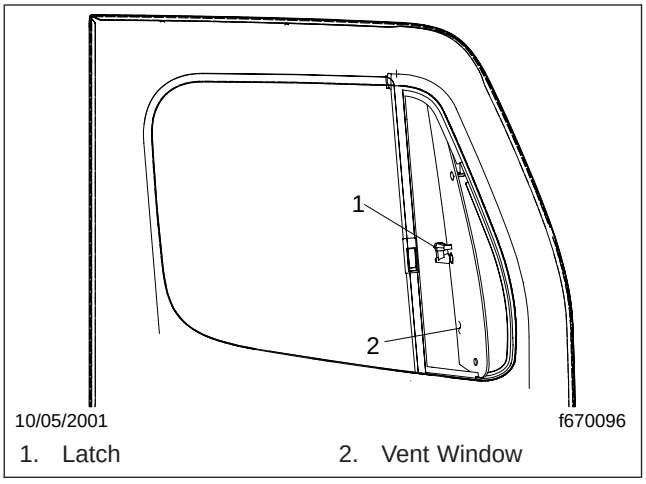
Press up to raise the window; press down to lower the window. Releasing the switch causes the window to stop.

Fig. 5.1, Power Window Switch

Standard vent (wing) windows do not open. Operating vent windows are optional. To open the operating vent window, turn the latch on the window and push the window open. See **Fig. 5.2**.



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1. Latch 2. Vent Window

Fig. 5.2, Operating Vent Window (optional)

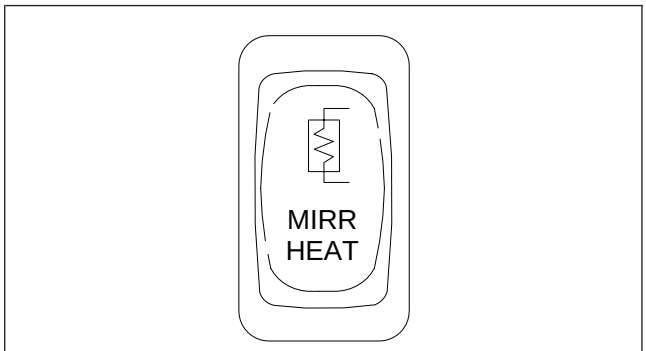
Mirrors

The standard outside mirrors are mounted on the door frame. There is a primary rear view mirror and a convex mirror.

Mirror Heat Switch, Optional

One or both outside door mirrors can be heated to keep them clear of fog, frost, and ice.

To heat the mirrors, press the upper part of the mirror heat switch (MIRR HEAT) on the dash. See **Fig. 5.3**. When the mirror heat switch is on, an amber indicator light illuminates inside the switch.



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To heat the mirrors, press up; press down to turn off the heat.

Fig. 5.3, Mirror Heat Switch

The mirror heat switch is a smart switch (fully multiplexed).

Power Mirrors, Optional

The main outside mirrors, if heated, can be equipped with an electrical remote control located on the driver's door. See **Fig. 5.4**.

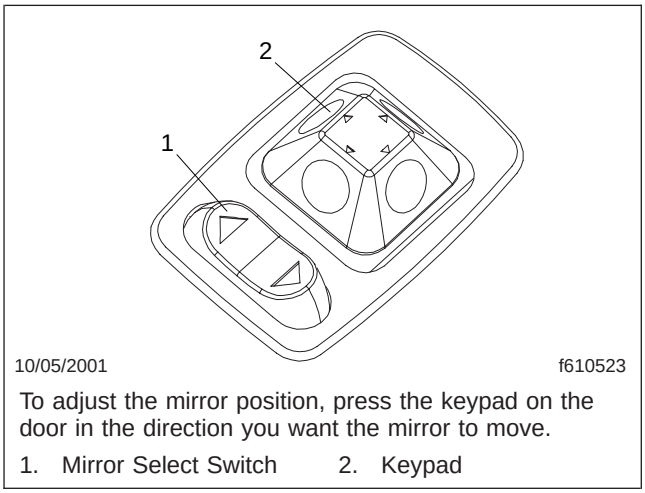
To select the mirrors on the left-hand side, press the left side of the mirror select switch. To select the mirrors on the right-hand side, press the right side of the mirror select switch.

The keypad has four arrow keys, pointing up, down, left, and right. To adjust the mirror position, press the keypad in the direction you want the mirror to move.

Down View Mirror, Optional

A down view mirror can be installed on the top of the passenger door frame to allow the driver a view of

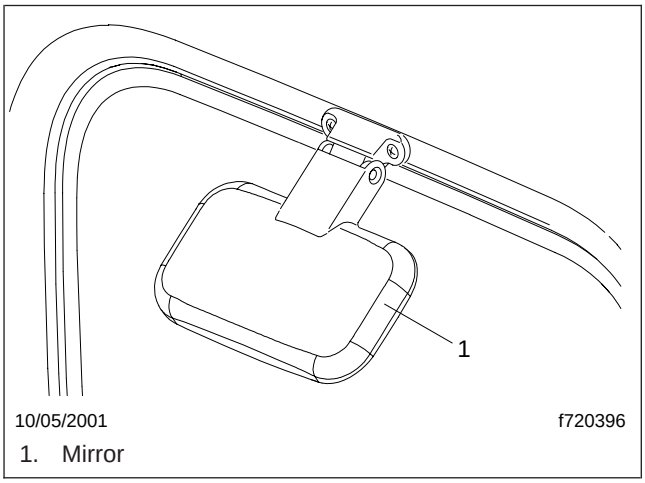
the area adjacent to the right side of the cab. See **Fig. 5.5**.



To adjust the mirror position, press the keypad on the door in the direction you want the mirror to move.

1. Mirror Select Switch 2. Keypad

Fig. 5.4, Power Mirror Switch Pad



1. Mirror

Fig. 5.5, Down View Mirror (optional)

Seats

General Information

WARNING

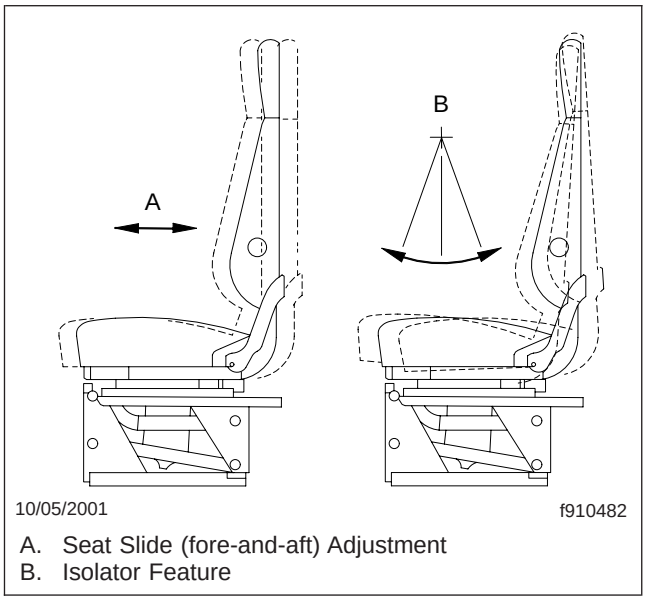
Keep hands, tools, and other objects away from the scissor points under the seats. Failure to do so could cause personal injury.

Unless otherwise noted, all seat adjustments should be made while seated and before the engine is started.

Due to the high degree of adjustability found in high-back air suspension seats, it is possible to set the seat back recline adjustment and the seat slide adjustment in such a combination that the seat back will come into contact with the rear wall of the cab. It is the responsibility of the driver to adjust the seat to prevent damage to the seat and the cab interior.

The following is a description of adjustments that are available on one or more seats. Not all seats have all of the adjustments listed below.

1. Seat Slide (fore-and-aft): When this adjustment is made, the entire seat moves forward or backward on its track (**Fig. 5.6**).



A. Seat Slide (fore-and-aft) Adjustment
B. Isolator Feature

Fig. 5.6, Seat Slide Adjustment and Isolator Feature

2. Isolator: This feature (also referred to as back-slap isolator or Chugger-Snubber®) reduces the amount of road shock by isolating the occupant from the motion of the vehicle, and allowing the upper seat to move in a simple pendulum motion. Whenever the isolator is not desired, it can be locked out (**Fig. 5.6**).
3. Lumbar Support: Lumbar support changes the shape of the seat back to give more or less support to the occupant's lumbar (lower back) area.

This adjustment is either mechanical or air controlled, depending on make and model of the seat (**Fig. 5.7**).

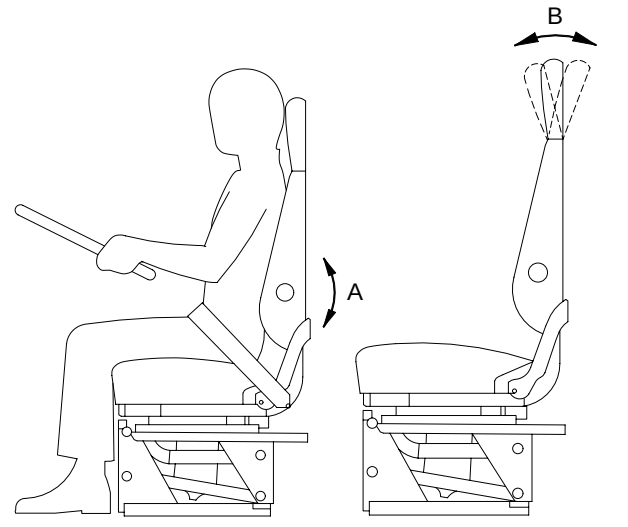


Fig. 5.7, Lumbar Support and Headrest Adjustment

4. Headrest: When this adjustment is made, the upper part of the backrest (back cushion) changes angle to provide head and upper back support (**Fig. 5.7**).
5. Backrest Tilt: This adjustment pivots the backrest forward or backward (**Fig. 5.8**).
6. Seat Cushion Tilt: This adjustment raises or lowers the front and/or back of the seat (bottom) cushion. This adjustment is easier to perform when all weight is removed from the seat (**Fig. 5.8**).
7. Seat Tilt: When this adjustment is made, the seat assembly, both backrest and seat cushion, tilts forward or backward (**Fig. 5.8**).
8. Ride Height Adjustment: The entire seat moves up or down when adjusting the ride height. The adjustment is either manual or air controlled, depending on the make and model of the seat (**Fig. 5.9**).
9. Damper: When you sit on the seat, a leveling valve places you in the center of the ride zone. When the damper is adjusted properly under normal driving conditions, the seat should not top or bottom against the limits of the vertical travel.

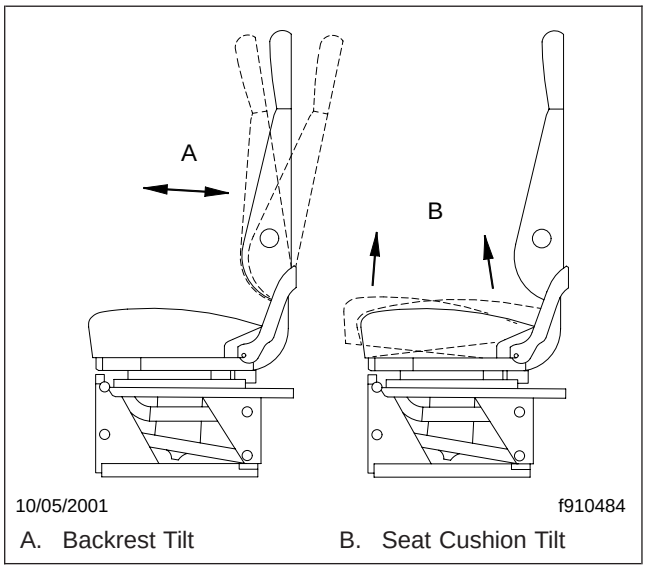


Fig. 5.8, Cushion Tilt Adjustments

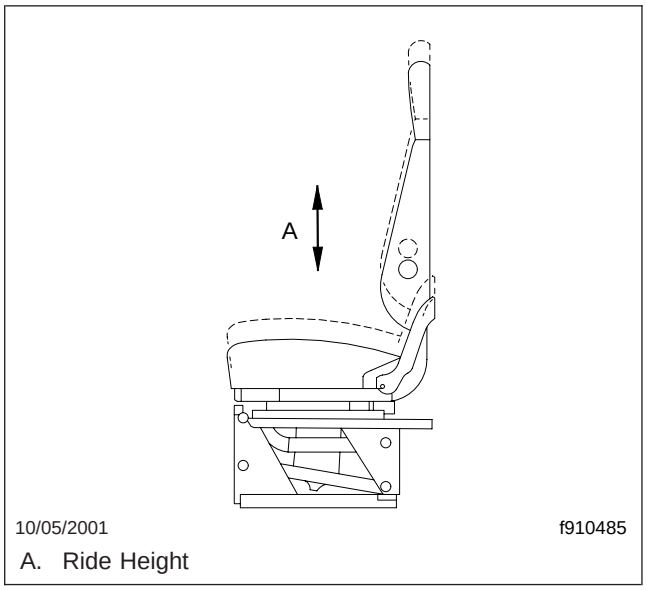
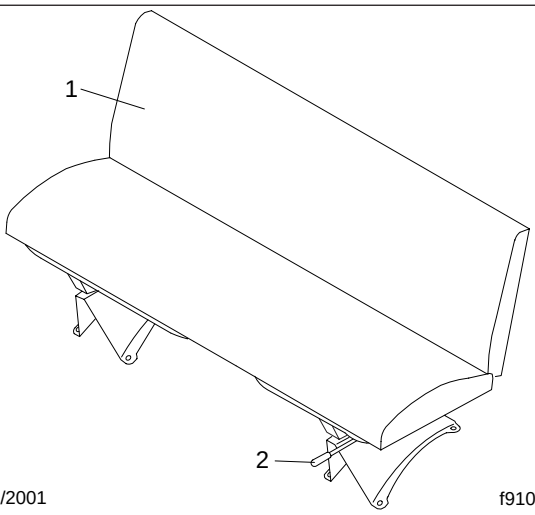


Fig. 5.9, Ride Height Adjustment

10. Ride Firmness: A firmer ride gives a better feel for the road but less protection against unevenness in the road surface. A softer ride smooths out the bumps.

Bench Seats

The three-person full bench seat is standard. See **Fig. 5.10**.



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1. Three-Person Seat
2. Seat Slide Lever

Fig. 5.10, Full Bench Seat

The full bench seat has a seat slide adjustment to allow more or less leg room for the driver and passengers. Release the seat slide lever and push backwards or forwards to move the seat along its track.

High-back air suspension seats are optional for both driver's and passenger's seats. Also available are a non-suspended passenger's seat, and a two-person bench seat with a safe or tool box located under the seat.

No adjustments are possible on the two-person bench seat or the non-suspended passenger seat.

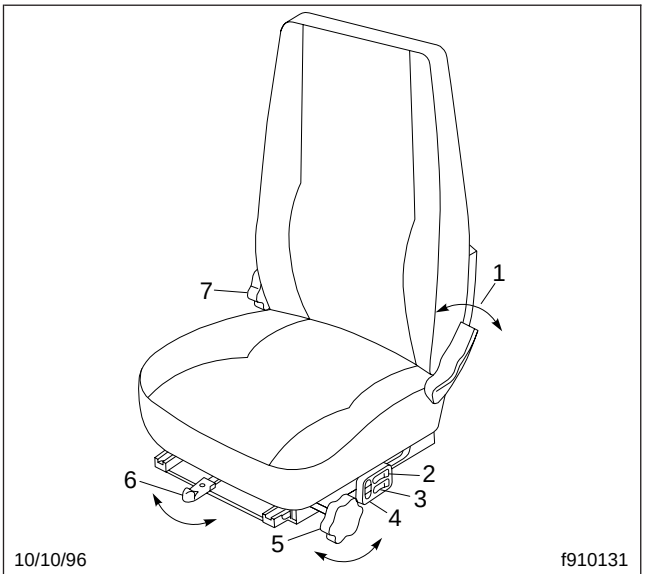
Bostrom Seat

Seat Slide Adjustment

Move the seat slide and isolator lever (**Fig. 5.11**) to the left and hold it there to slide the seat forward or backward to the desired position.

Isolator

To engage the isolator, put the seat slide and isolator lever in the center position. Lock out the isolator by moving the lever to the right.



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1. Backrest Tilt Lever
2. Air Lumbar Support Control Valve (optional)
3. Damper Adjustment Switch
4. Height Adjustment Switch
5. Seat Cushion Tilt Knob
6. Seat Slide and Isolator Lever
7. Lumbar Support Knob (standard)

Fig. 5.11, Bostrom Seat

Lumbar Support

To increase lumbar support, rotate the lumbar support knob forward. To decrease lumbar support, rotate the knob rearward.

On seats equipped with air lumbar support, press the control valve upward to increase lumbar support. Press the control valve downward to decrease lumbar support.

Seat Cushion Tilt

Rotate the seat cushion tilt knob to increase or decrease seat cushion tilt.

Backrest Tilt

To tilt the backrest, lean forward slightly to remove pressure from the cushion and hold the backrest tilt lever rearward. Lean backward slowly to the desired position and release the lever to lock the backrest in place.

Ride Height and Damper Adjustment

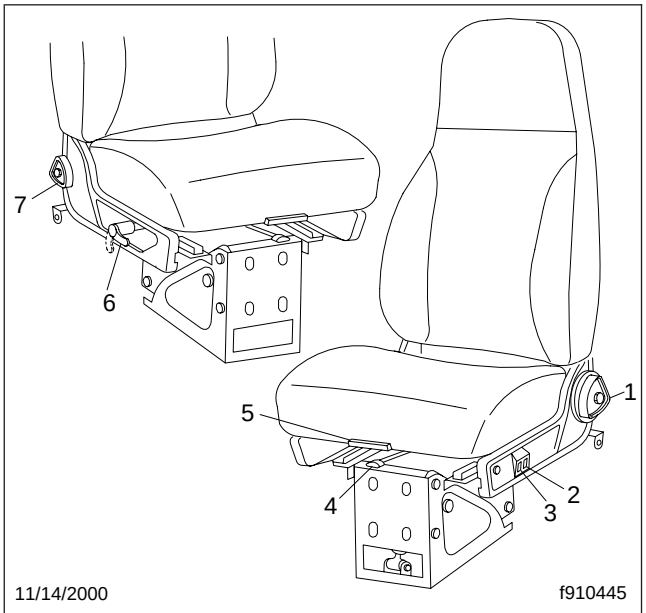
To raise the seat, press the upper portion of the height adjustment switch. To lower the seat, press the lower portion of the switch.

Press the damper adjustment switch to adjust the damper.

National 2000 Series Seat

Seat Slide Adjustment

Move the seat slide lever (**Fig. 5.12**) to the left and hold it there to slide the seat forward or backward to the desired position. Move the lever back to its original position to lock the seat in place.



1. Backrest Tilt Knob
2. Lumbar Support Switch
3. Height Adjustment Switch
4. Seat Slide Lever
5. Front Cushion Height Adjustment Handle
6. Isolator Handle
7. Rear Cushion Adjustment Knob

Fig. 5.12, National 2000 Series Seat

Isolator

To use the isolator feature, turn the isolator handle to the horizontal position. Turn the isolator handle down to lock out the isolator.

Lumbar Support

To adjust the lumbar support, use the lumbar support switch on the side of the seat to give more or less support to your lower back.

Backrest Tilt

To tilt the backrest, turn the backrest tilt knob until the desired position is reached.

Seat Cushion Adjustment

To adjust the height of the front of the seat cushion, lift the front cushion height adjustment handle, and pull forward or push back to the desired setting.

To adjust the height of the rear of the seat cushion, remove your weight from the seat and turn the rear cushion adjustment knob to one of three positions.

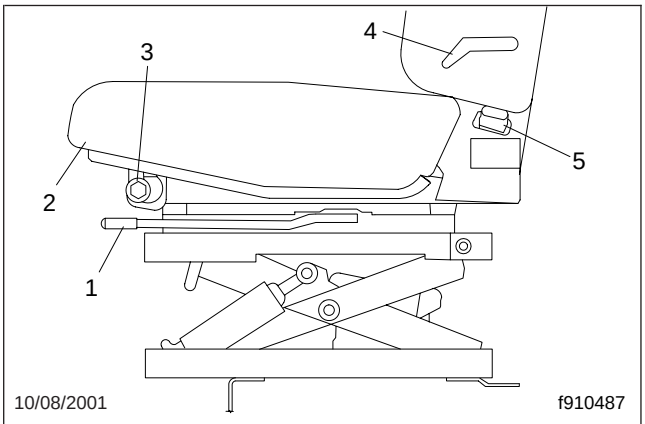
Ride Height Adjustment

To raise or lower the height of the seat, use the height adjustment switch on the side of the seat.

Sears Seat

Seat Slide Adjustment

Push the seat slide (fore-and-aft adjustment) lever (**Fig. 5.13**) all the way to the left and slide the seat forward or backward, as desired. Release the lever to lock the seat in the desired position.

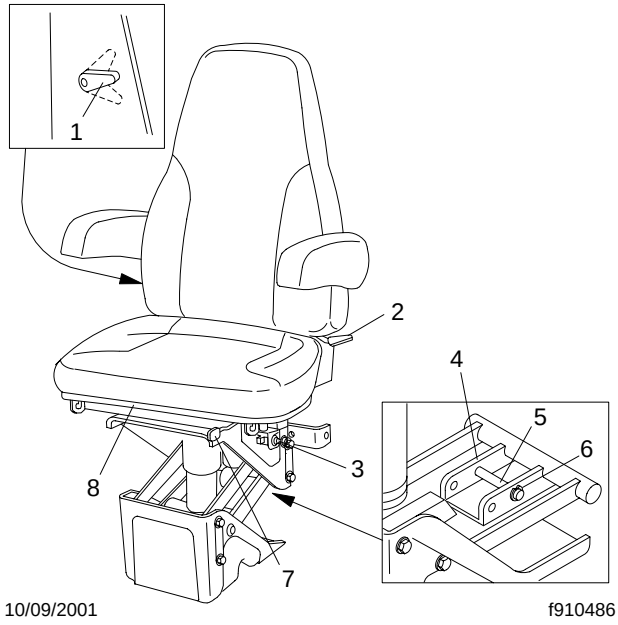


1. Seat Slide Lever
2. Seat Cushion Tilt Adjustment
3. Ride Height Knob
4. Lumbar Support Lever
5. Backrest Lever

Fig. 5.13, Sears Low Profile Seat

Isolator

To engage the isolator (if installed), move the seat slide and isolator lever (**Fig. 5.14**) all the way to the right. To lock out the isolator, move the isolator lever to the center position.



NOTE: Armrests are optional.

1. Lumbar Support Lever
2. Backrest Lever
3. Ride Height Knob
4. Shock Absorber Bracket (ride firmness)
5. Pin (ride firmness)
6. Snap Ring (ride firmness)
7. Seat Slide and Isolator Lever
8. Seat Cushion Adjustment

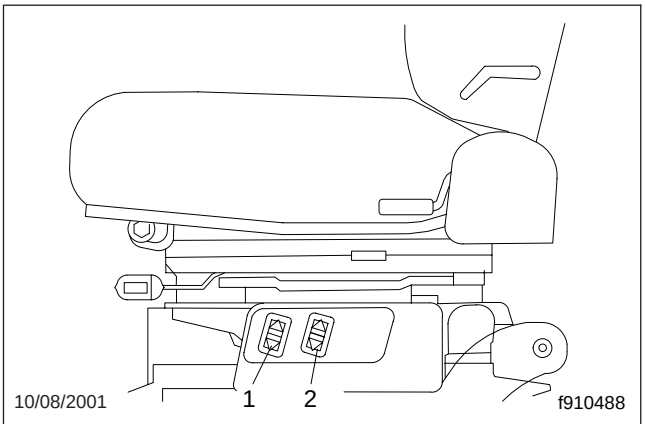
Fig. 5.14, Sears Fleetmaster Seat (with isolator)

Lumbar Support

Move the three-position lumbar support lever upward to increase lumbar support (firmer). Move the lever downward to decrease lumbar support (less firm).

NOTE: This three-position lever (see inset) does not rotate a full 360 degrees.

For seats with air support, use the aft rocker switch on the control panel on the left-hand side of the seat (**Fig. 5.15**). Press up to make the seat firmer; press down to make the seat less firm.



1. Ride Height Switch
2. Air Lumbar Support Switch

Fig. 5.15, Air Controls, Sears Seat

Seat Cushion Tilt

To raise the seat cushion, lift upward on the front of the seat cushion, and then push it rearwards. To lower the seat cushion, pull forward on the front of the seat cushion, and then push downwards.

Backrest Adjustment

To adjust the backrest, push downwards on the backrest lever just below the bottom of the backrest cushion. With the lever down, lean forward or backward to the desired position. Release the lever to lock the backrest in place.

Ride Height Adjustment

Push the ride height knob inwards to inflate the air cylinder, raising the height of the seat. Pull the ride height knob outwards to deflate the air cylinder, lowering the height of the seat.

For seats with air support, use the forward rocker switch on the control panel on the left-hand side of the seat (**Fig. 5.15**). Press up to raise the seat; press down to lower the seat.

Ride Firmness Adjustment

For a softer ride, remove the snap ring and pin from the shock absorber bracket (see inset). Relocate the pin in the other set of holes in the bracket and secure it with the snap ring.

Seat Belts and Tether Belts

General Information

Seat belt assemblies are designed to secure persons in the vehicle to help reduce the chance of injury or the amount of injury resulting from accidents or sudden stops. For this reason, Daimler Trucks North America LLC urges that the driver and *all* passengers, regardless of age or physical condition, use seat belts when riding in the vehicle.

⚠ WARNING

Always use the vehicle's seat belt system when operating the vehicle. Failure to do so can result in severe personal injury or death.

Seat belt assemblies in Daimler Trucks North America (DTNA) vehicles meet Federal Motor Vehicle Safety Standard 209, "Type 1" and "Type 2" requirements.

When transporting a child, always use a child restraint system or the vehicle seat belts as appropriate. To determine whether a child restraint system is required, review and comply with applicable state and local laws. Any child restraint used must comply with Federal Motor Vehicle Safety Standard 213, "Child Restraint Systems." When providing a child restraint system, always carefully read and follow all instructions pertaining to installation and usage for the child. Make certain the child remains in the restraint system at all times when the vehicle is in motion.

In addition to seat belt assemblies, tether belts are installed on suspension-type seats. Tether belts help secure the seat to the floor and are intended to restrain the seat and seat belt in case of an accident or sudden stop.

IMPORTANT: Seat belts have a finite life which may be much shorter than the life of the vehicle. Regular inspections and replacement as needed are the only assurance of adequate seat belt security over the life of the vehicle.

Seat Belt Inspection

⚠ WARNING

Inspect and maintain seat belts. When any part of a seat belt system needs replacement, the entire seat belt must be replaced, both retractor and buckle side. Any time a vehicle is involved in an accident, and the seat belt system was in use, the entire vehicle seat belt system must be replaced before operating the vehicle. Do not attempt to modify the seat belt system; doing so could change the effectiveness of the system. Failure to replace worn or damaged seat belts, or making any modifications to the system, may result in personal injury or death.

Inspect the seat belts and tether belts (if so equipped).

1. Check the web for fraying, cuts, extreme dirt and dust, or for severe fading from exposure to sunlight, especially near the buckle latch plate and in the D-loop guide area.
2. Check operation of the buckle, latch, Komfort Latch or Sliding Komfort Latch (if equipped), web retractor, and upper seat belt mount on the door pillar. Check all visible components for wear or damage.
3. Check the seat belt and tether belt connection points and tighten any that are loose.

Seat Belt Operation

Three-Point Seat Belt With Komfort Latch or Sliding Komfort Latch

⚠ WARNING

Wear three-point seat belts only as described below. Three-point seat belts are designed to be worn by one person at a time. In case of an accident or sudden stop, personal injury or death could result from misuse.

Fasten the seat belts before driving. Fastening a three-point seat belt while driving creates a hazard.

When engaged and used properly, the Komfort Latch (**Fig. 5.16**) and the Sliding Komfort Latch (**Fig. 5.17**)

introduce a small amount of slack into the seat belt, resulting in a more comfortable ride.

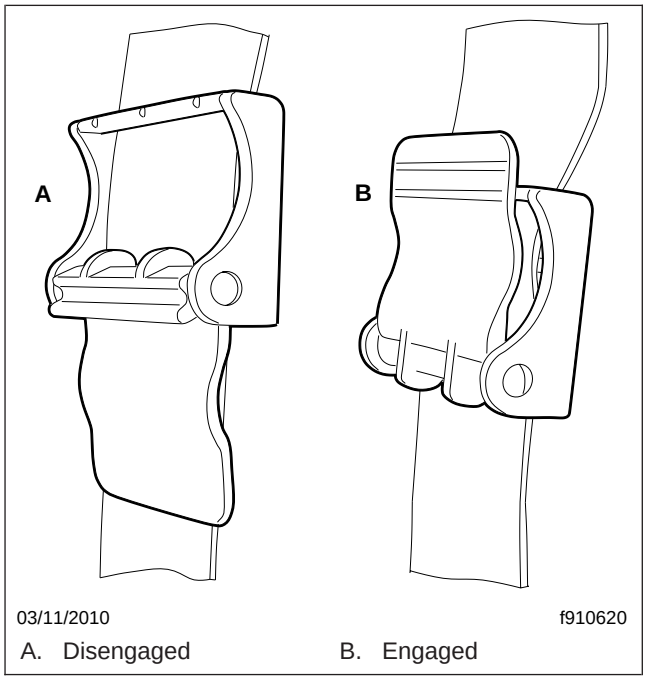


Fig. 5.16, Komfort Latch

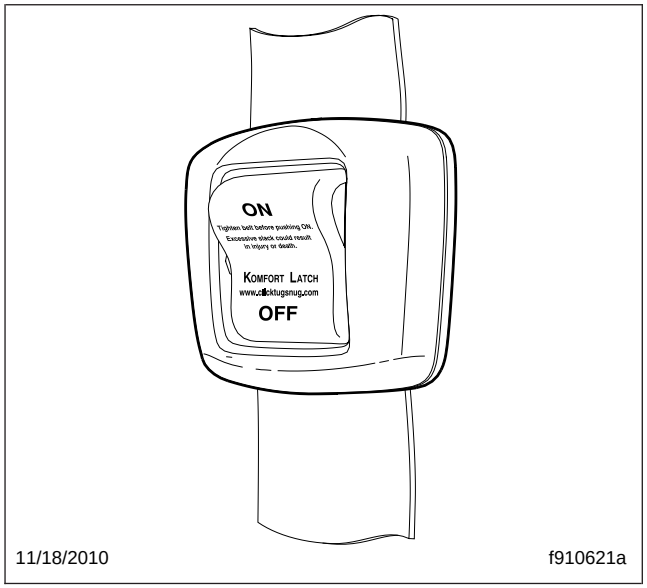


Fig. 5.17, Sliding Komfort Latch

1. Slowly pull the latch end of the three-point seat belt out of the retractor and pull it across your lap (from outboard to inboard) far enough to engage the buckle. If the retractor locks too soon, allow the belt to retract slightly, then slowly pull it out again.
2. Fasten the three-point seat belt by pushing the latch into the buckle. Listen for an audible click. See **Fig. 5.18**.

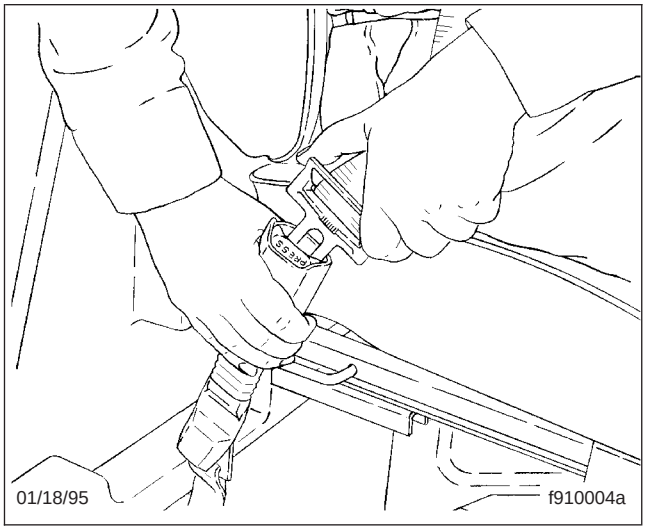
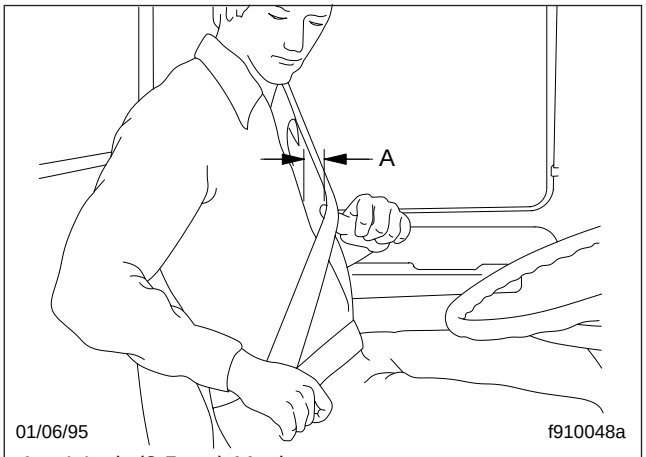


Fig. 5.18, Fastening the Three-Point Belt

3. Tug on the seat belt to make sure it is securely fastened. If the buckle unlatches, repeat this step. If the problem continues, replace the three-point seat belt.
4. Snug the seat belt to your waist.
5. Position the shoulder strap diagonally across your chest with the adjustable D-loop bracket (if equipped). If desired, engage the Komfort Latch or Sliding Komfort Latch as follows.

   If equipped with a Sliding Komfort Latch, make sure that the shoulder strap is snug against your chest. Without loosening the shoulder strap, push the Sliding Komfort Latch switch to the "ON" position. See **Fig. 5.17**. To activate the latch lean forward until you hear a click. This will allow for approximately 1 inch (2.5 cm) of slack between your chest and the shoulder harness. Once engaged, the latch will allow you to lean forward about 5 inches (13 cm) without having to reset the latch. Leaning forward more than 5 inches (13 cm) will disengage the Sliding Komfort Latch, requiring it to be reset.

If equipped with a Komfort Latch, pull on the shoulder strap to lessen the pressure of the strap on your shoulder and chest. Allow no more than 1 inch (2.5 cm) of slack between your chest and the shoulder harness. More slack can significantly reduce the seat belt effectiveness in an accident or a sudden stop. While holding the belt slack, press the Komfort Latch lever up, clamping the seat belt webbing (**Fig. 5.19** and **Fig. 5.20**).



A. 1 Inch (2.5 cm) Maximum

Fig. 5.19, Adjusting Shoulder Harness Clearance, Komfort Latch

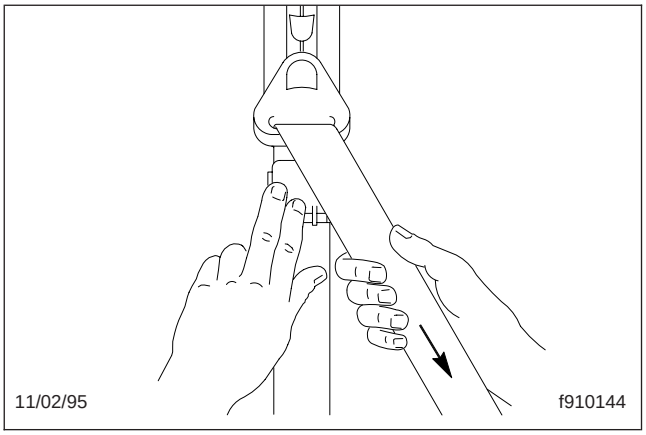


Fig. 5.20, Locking the Komfort Latch

6. Unbuckle the three-point seat belt and release the Komfort Latch or the Sliding Komfort Latch as follows.

   If equipped with a Sliding Komfort Latch, unbuckle the seat belt, then tug on the shoulder belt to release the Sliding Komfort Latch, *or* press the Sliding Komfort latch to the "OFF" position, then unbuckle the seat belt.

   If equipped with a Komfort Latch, unbuckle the seat belt, then release the Komfort Latch by giving the shoulder belt a quick tug. If you lean forward against the shoulder belt, the Komfort Latch will automatically release, and will need to be reset.

NOTE: Neither the Komfort Latch nor the Sliding Komfort Latch need to be manually released in an emergency situation. Each will release by itself under rough road or other abnormal conditions. Make sure the three-point seat belt is completely retracted when it is not in use.

Air Bag, Optional

Your vehicle may or may not be equipped with a driver's air bag supplemental restraint system.

The air bag, when used with seat belts, provides additional protection to the driver in severe frontal collisions. The operational readiness of the air bag system is indicated by the supplemental restraint system (SRS) indicator on the dash. The SRS indicator comes on when the engine is started and then goes off. The indicator will remain on if there is a problem with the air bag system. The vehicle should be serviced if the SRS indicator does not come on when the engine is started or if the SRS indicator remains on.

⚠ WARNING

Air bags are designed to inflate only in severe frontal collisions. The driver and the passenger should always wear seat belts. For maximum protection in a collision or rollover, always be in a normal seated position with your back against the seat back and your head upright. Fasten your seat belt and ensure that it is properly positioned on your body as described under the "Seat Belt Operation" heading. Since the air bag inflates with considerable speed and force, a proper seat position will keep you a safe distance from the inflating air bag.

Do not place objects on the steering wheel or between you and the steering wheel. Keep your hands on the sides and lower portion of the

steering wheel. Any objects may cause harm during an accident.

Failure to follow these instructions may result in death or personal injury.

Air Bag Safety Guidelines

The air bag system contains components that use combustible chemicals. Because these chemicals are combustible, care must be taken when replacing or handling system components.

⚠ WARNING

Consider undeployed air bags to be dangerous and capable of deploying at any time. Do not attempt to service the air bag system unless trained to do so. Damaged air bag systems should be examined by qualified personnel before any attempt is made to remove or to deploy the air bag. All intentional deployments and testing of the system should be performed by trained personnel. Unintentional or improper air bag deployment could cause severe bodily injury or death.

Do not attempt to disassemble the air bag inflator unit or breach the integrity of the sealed metallic inflator case. Doing so could cause severe bodily injury or death.

Do not allow system chemicals to contact other liquids, combustibles, and flammable materials. Doing so could cause chemical burns or personal injury.

The surface of the deployed air bag may contain small amounts of sodium hydroxide (which is a by-product of the gas generant combustion) and metallic sodium. Sodium hydroxide may be irritating to the skin and eyes. Always wear rubber gloves and safety glasses when handling a deployed air bag. Immediately wash your hands and exposed skin areas with a mild soap and water. Flush your eyes immediately if exposed to sodium hydroxide.

Review and comply with the following list of warnings. Failure to do so could result in severe injury or death.

- **Keep all liquids, acids, halogens, heavy metals, and heavy salts away from the air bag system.**
- **Do not cut, drill, braze, solder, weld, strike, or probe any part of the air bag system.**
- **Do not expose the air bag module to electricity. Never probe a circuit.**
- **Do not attempt to adapt, reuse, or install an air bag system in any vehicle other than the specific vehicle for which it is designed.**
- **Do not cut wires or tamper with the connector between the vehicle wiring harness and the air bag module. Cutting or removing the connector from the system will disable the safety shunt and could cause unintentional deployment.**
- **Allow deployed air bag systems to cool after deployment.**
- **Wear rubber gloves and safety glasses when handling a deployed air bag.**
- **Wash your hands and exposed skin surface areas immediately after handling a deployed system.**
- **Store, transport, dispose of, and recycle deployed air bag system components in accordance with all applicable federal, state, and local regulations.**
- **The air bag module may contain perchlorate material: special handling may apply, see www.dtsc.ca.gov/hazardouswaste/perchlorate.**
- **Keep all heavy objects in the cab secured.**

Cab Amenities

Cup Holders

There are two cup holders molded into the lower part of the auxiliary dash panel, one on either side of the HVAC control head.

Cab Storage

There are storage bins in the dash and the overhead console. On vehicles with optional individual driver's and passenger seats, there is a center storage console between the seats.

There is a dash storage bin located under the cup holders on the center panel. The bin has a hinged

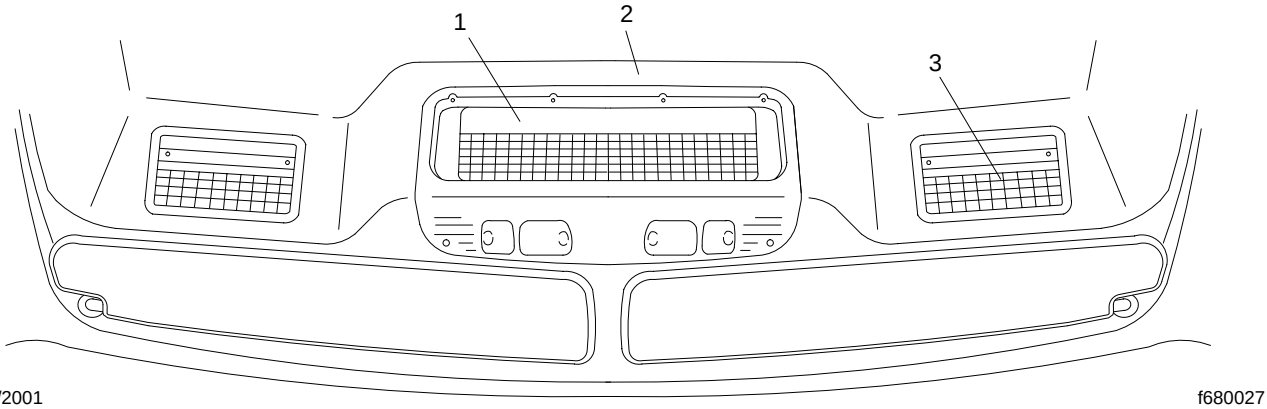
cover and can be used to store sunglasses. There is also a small storage pocket above the radio.

Overhead Storage

Vehicles without an overhead console have two storage bins located above the windshield.

On vehicles equipped with an overhead console, most vehicles have a storage bin located in the overhead console. See **Fig. 5.21**. The overhead storage bin is often removed and replaced with a CB radio.

Two map holders with netted openings are located overhead, one on either side of the overhead console.



1. Overhead Storage Bin
2. Overhead Console
3. Map Holder Netting

Fig. 5.21, Overhead Storage

Center Storage Console (optional)

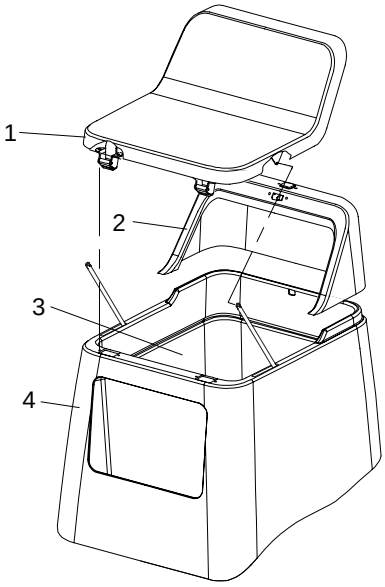
On vehicles with individual driver's and passenger's seats, a center storage console can be installed between the seats.

The center storage console has a table top that can be lifted up to deploy a writing surface. See **Fig. 5.22**.

In another version, the center storage console has a printer top with a paper slot in it. See **Fig. 5.23**.

Windshield Washer Reservoir

The standard location for the windshield washer reservoir is on the right-hand side of the cab underneath the door, just above the trailing edge of the top cab step. See **Fig. 5.24**.



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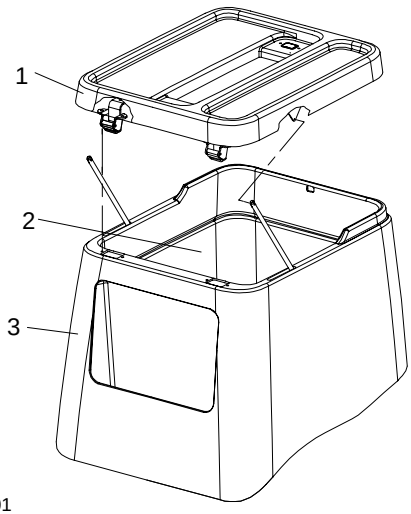
1. Table Top
2. Storage Console Cover
3. Storage Area
4. Storage Console Base

Fig. 5.22, Center Storage Console (with writing surface)



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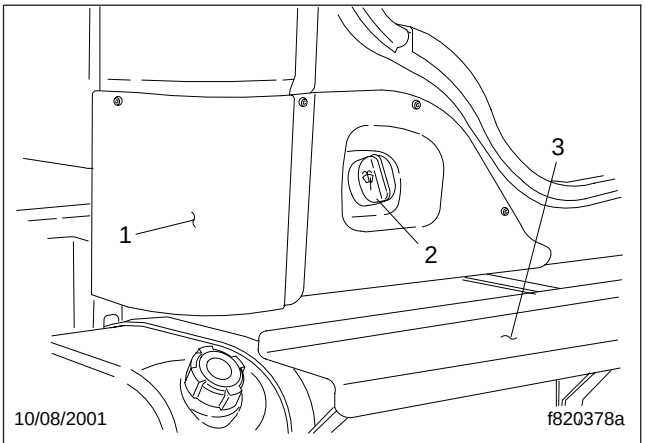
1. Printer Top
2. Printer/Paper Area
3. Storage Console Base

Fig. 5.23, Center Storage Console (printer option)



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1. Cab
2. Washer Reservoir Fill Cap
3. Top Step

Fig. 5.24, Windshield Washer Reservoir

6

Heater, Ventilator and Air Conditioner

Climate Control Panel 6.1

Climate Control Panel

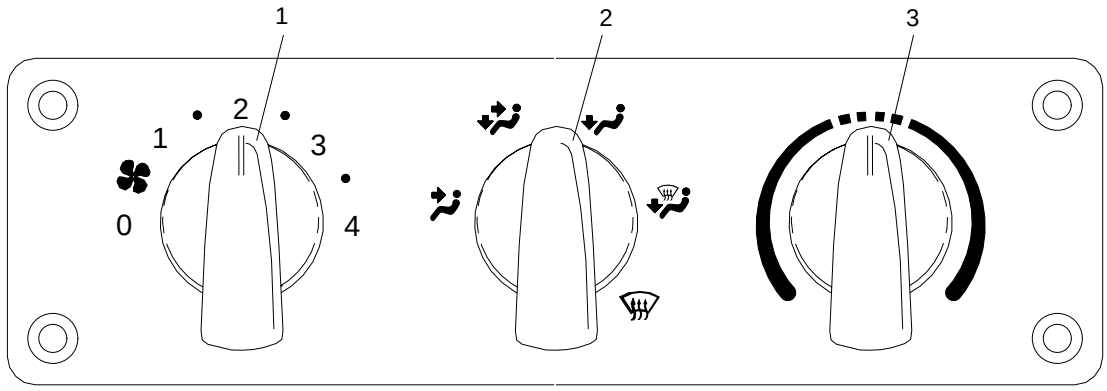
The climate control panel allows you to control the heating, ventilating, defrosting, and air conditioning functions. The climate control panel without air conditioning is shown in **Fig. 6.1**. The climate control panel with air conditioning is shown in **Fig. 6.2**.

Fan Switch

The fan switch controls the fan speed and forces fresh or recirculated air through the air outlets. The fan switch has eight fan speeds and an off position. To increase airflow, turn the fan switch to the right or to a higher number. To decrease the airflow, turn the switch to the left or to a lower number.

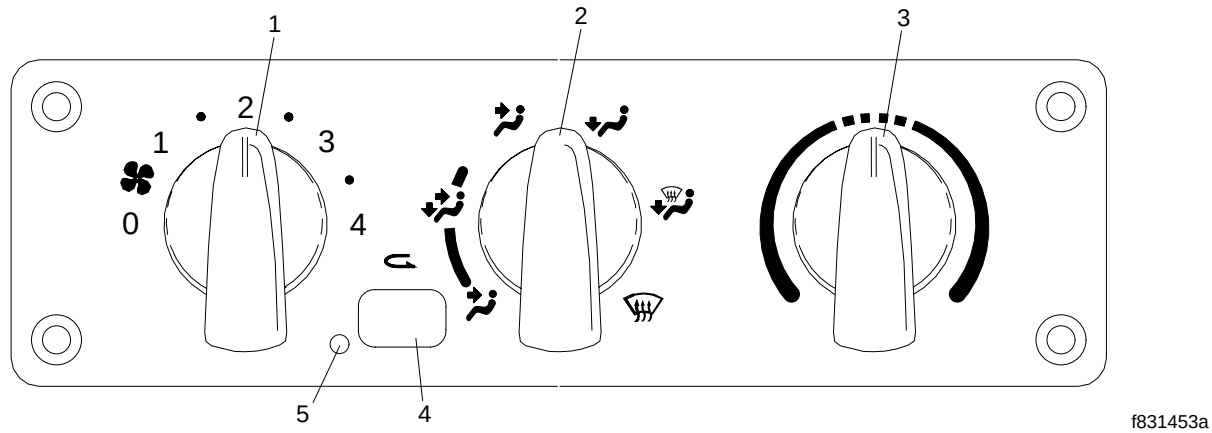
Air Selection Switch

The air selection switch allows you to control the flow of air through the face outlets, the floor outlets, the defrost (windshield) outlets, or a combination of these outlets to give you nine air selection modes on a system without air conditioning. See **Fig. 6.3**. A system with air conditioning has 11 air selection



1. Fan Switch
2. Air Selection Switch
3. Temperature Control Switch

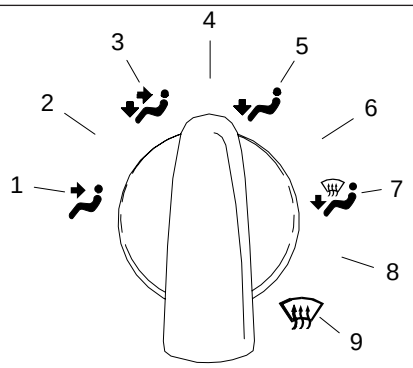
Fig. 6.1, Climate Control Panel Without Air Conditioning



1. Fan Switch
2. Air Selection Switch
3. Temperature Control Switch
4. Recirculation Button
5. Recirculation Indicator

Fig. 6.2, Climate Control Panel With Air Conditioning

modes, four of which are air conditioning modes. See **Fig. 6.4**.



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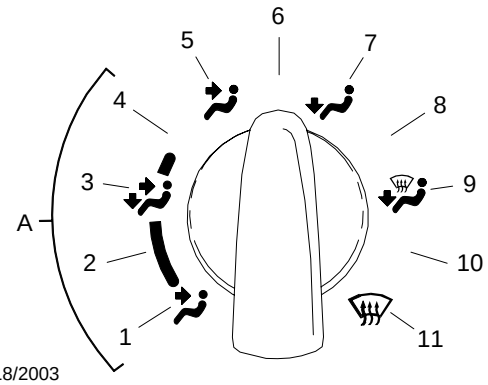
1. Face Mode
2. Selection Between Face Mode and Bi-Level Mode
3. Bi-Level Mode
4. Selection Between Bi-Level Mode and Floor Mode
5. Floor Mode
6. Selection Between Floor Mode and Floor/Defrost Mode
7. Floor/Defrost Mode
8. Selection Between Floor/Defrost Mode and Defrost Mode
9. Defrost Mode

Fig. 6.3, Air Selection Switch Without Air Conditioning

Air Selection Switch Without Air Conditioning

1. **Face Mode:** Directs all airflow through the face or instrument panel outlets.
2. **Selection between Face Mode and Bi-Level Mode:** Directs 75 percent of the airflow through the face outlets and 25 percent through the floor outlets.
3. **Bi-Level Mode:** Directs the airflow equally to the face outlets and the floor outlets.
4. **Selection between Bi-Level Mode and Floor Mode:** Directs 25 percent of the airflow through the face outlets and 75 percent through the floor outlets.
5. **Floor Mode:** Directs all airflow through the floor outlets.
6. **Selection between Floor Mode and Floor/ Defrost Mode:** Directs 75 percent of the airflow through the floor outlets and 25 percent through the defrost outlets.
7. **Floor/Defrost Mode:** Directs the airflow equally to the floor outlets and the defrost outlets.
8. **Selection between Floor/Defrost Mode and Defrost Mode:** Directs 75 percent of the airflow through the defrost outlets and 25 percent through the floor outlets.
9. **Defrost Mode:** Directs all airflow through the defrost outlets.



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A. Air Conditioning Modes
1. Air Conditioning Face Mode
2. Selection Between Air Conditioning Face Mode and Air Conditioning Bi-Level Mode
3. Air Conditioning Bi-Level Mode
4. Selection Between Air Conditioning Bi-Level Mode and Face Mode
5. Face Mode
6. Selection Between Face Mode and Floor Mode
7. Floor Mode
8. Selection between Floor Mode and Floor/Defrost Mode
9. Floor/Defrost Mode
10. Selection between Floor/Defrost Mode and Defrost Mode
11. Defrost Mode

Fig. 6.4, Air Selection Switch With Air Conditioning

Air Selection Switch With Air Conditioning

1. **Air Conditioning Face Mode:** Directs all airflow through the face or instrument panel outlets.
2. **Selection between the Air Conditioning Face Mode and the Air Conditioning Bi-Level**

Mode: Directs 75 percent of the airflow to the face outlets and 25 percent to the floor outlets.

3. **Air Conditioning Bi-Level Mode:** Directs the airflow equally to the face outlets and the floor outlets.
4. **Selection between the Air Conditioning Bi-Level Mode and the Face Mode:** Directs 25 percent of the airflow to the face outlets and 75 percent to the floor outlets.
5. **Face Mode:** Directs all airflow through the face outlets.
6. **Selection between Face Mode and Floor Mode:** Directs the airflow equally through the face outlets and the floor outlets.
7. **Floor Mode:** Directs all airflow through the floor outlets.
8. **Selection between Floor Mode and Floor/Defrost Mode:** Directs 75 percent of the airflow through the floor outlets and 25 percent through the defrost outlets.
9. **Floor/Defrost Mode:** Directs the airflow equally to the floor outlets and the defrost outlets. The recirculation button will not work in this mode.
10. **Selection between Floor/Defrost Mode and Defrost Mode:** Directs 75 percent of the airflow through the defrost outlets and 25 percent through the floor outlets. The recirculation button will not work in this mode.
11. **Defrost Mode:** Directs all airflow through the defrost outlets. The recirculation button will not work in this mode.

Temperature Control Switch

The temperature control switch is used to select the desired temperature. Turn the switch to the left (counterclockwise) for cool air, or to the right (clockwise) for hot air. There are 21 positions on the temperature control switch ranging from full cool air to full hot air.

Fresh Air Mode

Fresh air, or outside air, is circulated through the heating and air conditioning system unless the recirculation mode, if equipped, is turned on.

Recirculation Mode

The recirculation mode is only available on vehicles with air conditioning.

The recirculation mode limits the amount of outside air entering the cab. Press the recirculation button to prevent dusty or smoky air from entering the cab. The recirculation mode can also be used to decrease the time required to cool or heat the cab interior during extreme outside temperature conditions. When the recirculation mode is on, the recirculation indicator will be on. See **Fig. 6.2**.

The recirculation mode is not available when the air selection switch is in one of the following modes:

- floor/defrost mode
- selection between floor/defrost mode and defrost mode
- defrost mode

When the recirculation mode is turned on, it will stay on for 20 minutes, or until the recirculation button is pressed again, or the air selection switch is turned to a defrost mode.

IMPORTANT: On vehicles built before May 2, 2003, the recirculation mode turns off after twenty minutes and can be turned back on when the recirculation button is pressed again. On vehicles built from May 2, 2003, the system enters a partial recirculation mode for five minutes after being in full recirculation mode for 20 minutes. This cycle repeats as long as the system is in recirculation mode.

NOTE: To prevent the buildup of fumes or odors inside the cab on a vehicle built before May 2, 2003, do not use the recirculation mode for more than 20 minutes. It is recommended that the recirculation mode remains off for five minutes before it is turned back on.

Defrosting

Before using any of the defrost modes, clear the screen at the base of the windshield if snow or ice is present.

Air Conditioning, Optional

There are four air conditioning modes on the air selection switch. The air conditioning settings on the air selection switch are blue, in addition to the selection between the air conditioning bi-level mode and the face mode.

IMPORTANT: Operate the air conditioner at least five minutes each month, even during cool weather. This helps prevent drying and cracking of the refrigerant compressor seals and reduces the chance of refrigerant leaks in the system.

NOTE: The heating and air conditioning system has a brushless blower motor with a protection or shutdown mode to prevent damage due to overheating and overcurrent conditions. If the brushless blower motor goes into a protection mode, the motor will operate at a slower speed. If the overheating or overcurrent condition continues, the motor will shut down and stop completely.

The motor will resume proper operation after the motor has cooled or the overcurrent condition has been resolved. It will be necessary to cycle the fan switch off, and then on, to reset the motor. If the problem appears repeatedly, take the vehicle to an Freightliner dealer or authorized service outlet for repairs.

7

Engines

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Exhaust Braking Systems 7.15

Aftertreatment System (ATS)

IMPORTANT: EPA07 and EPA10 emissions regulations apply to vehicles domiciled in Canada and the USA at the time of printing this manual. Vehicles that are domiciled outside of the USA and Canada may not have EPA07- or EPA10-compliant engines with an emission aftertreatment system, depending upon local statutory emissions guidelines.

EPA07 Aftertreatment System (ATS)

On-road diesel engines built after December 31, 2006 are required to meet EPA07 guidelines for reduced exhaust emissions of particulate matter and nitrogen oxides (NOx). NOx is limited to just over 1 gram per brake horsepower hour (g/bhp-hr), and particulate matter cannot exceed 0.01 g/bhp-hr.

EPA07-compliant engines require ultralow-sulfur diesel (ULSD) fuel, and they should never be run on fuel with sulfur content higher than 15 ppm. In addition, they require low-ash engine oil. The following guidelines must be followed, or the warranty may be compromised.

- Use ultralow-sulfur diesel (ULSD) with 15 ppm sulfur content or less, based on ASTM D2622 test procedure.
- Do not use fuel blended with used engine lube oil or kerosene.
- Engine lube oil must have a sulfated ash level less than 1.0 wt %, meeting the API CJ-4 index specifications.

IMPORTANT: Using non-specification fuels or oils can lead to shortened diesel particulate filter (DPF) cleaning or exchange intervals. For example, using CI-4+ oil with 1.3% sulfated ash (30% more ash content) may result in the need for DPF cleaning or exchange 20 to 30% sooner than would normally be required.

The "exhaust system" in EPA07-compliant vehicles is called the aftertreatment system (ATS). The ATS varies according to engine manufacturer and vehicle configuration, but instead of a muffler, an aftertreatment system has a device that outwardly resembles a muffler, called the aftertreatment device (ATD).

IMPORTANT: See your engine operation manual for complete details and operation of the aftertreatment system.

Inside the ATD on Mercedes-Benz, Detroit Diesel, and Cummins engines, the exhaust first passes over the diesel oxidation catalyst (DOC), then it passes through the DPF, which traps soot particles. If exhaust temperature is high enough, the trapped soot is reduced to ash, in a process called passive regeneration (regen). **Passive regeneration** occurs as the vehicle is driven normally under load; the driver is not even aware that it is happening. The harder an EPA07 engine works, the better it disposes of soot, as the exhaust heat alone is enough to burn the soot to ash. Over the course of a workday, however, passive regeneration cannot always keep the ATD filter clean, so the filter must undergo **active regeneration**.

In active regeneration, extra fuel is injected into the exhaust stream to superheat the soot trapped in the DPF and turn it to ash. Active regeneration happens only when the vehicle is moving above a certain speed, determined by the engine manufacturer. Consult manufacturers' documentation for details. Both active and passive regeneration happen automatically, without driver input.

If conditions do not provide for at-speed active regeneration, the vehicle will need a driver-activated **parked regeneration**. The vehicle must be standing still, and the driver must initiate parked regen. Completing a parked regen takes 20 minutes to an hour, depending on ambient conditions.

⚠ DANGER

During parked regeneration, exhaust temperatures are very high, and could cause a fire, heat damage to objects or materials, or personal injury to persons near the exhaust outlet.

Before initiating a parked regeneration, make certain the exhaust outlets are directed away from structures, trees, vegetation, flammable materials, and anything else that may be damaged or injured by prolonged exposure to high heat.

There are three warning lamps in the driver message center that alert the driver of the need to perform a parked regen, clean the filter, or of an engine fault that affects the emissions.

A slow (10-second) flash of the high exhaust system temperature (HEST) lamp, indicates a regeneration is in progress, and the driver is not controlling the engine idle speed.

A solid illuminated high exhaust system temperature (HEST) lamp, alerts the operator of high exhaust temperature during the regeneration process, when the speed is below 5 mph (8 km/h). See **Fig. 7.1**. The HEST lamp does not indicate the need for any kind of vehicle or engine service; it only alerts the vehicle operator of high exhaust temperatures. The driver must be careful that the exhaust pipe outlet is not directed at any person, or at any object or material that can be damaged or ignited by the heat.

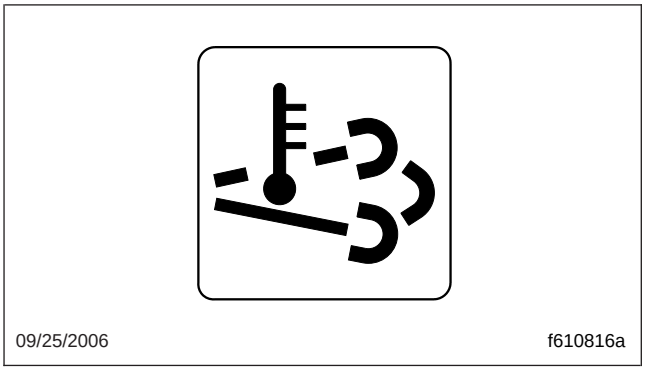


Fig. 7.1, High Exhaust System Temperature (HEST) Lamp

⚠ WARNING

Active regeneration can occur automatically anytime the vehicle is moving. The exhaust gas temperature could reach 1500°F (800°C), which is hot enough to cause a fire, heat damage to objects or materials, or personal injury to persons near the exhaust outlet. See *Regen-Inhibit Switch* later in this chapter for instructions on preventing automatic regen if necessary.

The exhaust temperature can remain high even after the vehicle has stopped. When stopping the vehicle shortly after an automatic regen, ensure the exhaust outlets are directed away from structures, trees, vegetation, flammable materials, and anything else that may be damaged or injured by exposure to high heat.

A steady yellow DPF lamp indicates that a parked regen is required soon, and should be scheduled for the earliest convenient time. See **Fig. 7.2**. A blinking

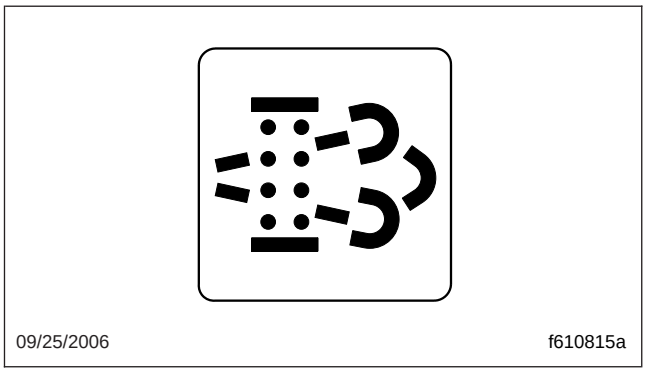


Fig. 7.2, Diesel Particulate Filter (DPF) Status Lamp

yellow DPF lamp indicates that a parked regen is required immediately, or an engine derate may occur.

A solid yellow malfunction indicator lamp (MIL) indicates an engine fault that affects the emissions. See **Fig. 7.3**.

Diesel particulate filter servicing must be performed by an authorized service facility, and a record must be maintained for warranty purposes. The record must include:

- date of cleaning or replacement;
- vehicle mileage;
- particulate filter part number and serial number.

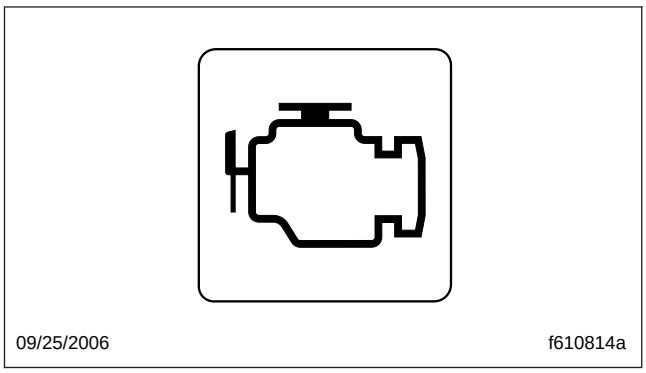


Fig. 7.3, Malfunction Indicator Lamp (MIL)

The request regen switch is located on the dash. See **Fig. 7.4** . The function of the switch varies by the engine make and model in the vehicle. See the engine operation manual for switch operation details.

NOTE: The regen switch can start an active regen only when the DPF light is illuminated

because the engine software calls for a manual regen.

The regen-inhibit switch provides additional control over the aftertreatment regeneration process. A driver may decide to use this feature if they are hauling cargo that should not be exposed to possible high exhaust temperatures from an automatic regen. When activated, the inhibit switch will stop a regeneration cycle in progress, and prevent the start of a regeneration cycle until the switch is no longer active. See **Fig. 7.5**.

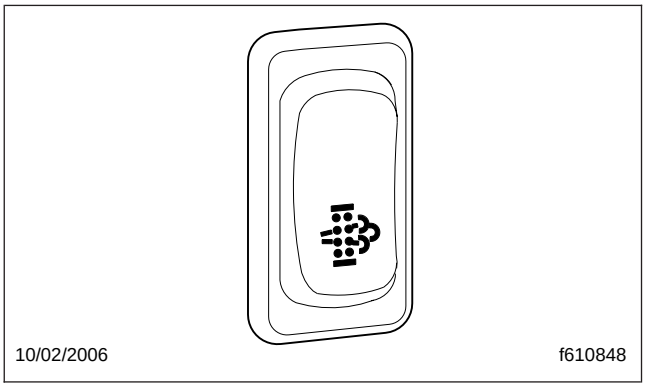


Fig. 7.4, Request Regen Switch

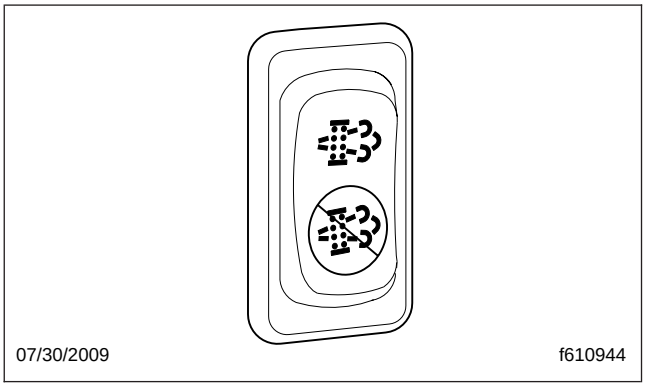


Fig. 7.5, Regen-Inhibit Switch

EPA10 Aftertreatment System (ATS)

The EPA mandates that all engines built after December 31, 2009 must reduce the level of emissions exhausted by the engine to the following levels:

- Nitrogen Oxides (NOx) – 0.2 g/bhp-hr
- Particulate Matter (PM) – .01 g/bhp-hr

To meet EPA guidelines, diesel engines installed in Daimler Trucks North America (DTNA) chassis for domicile in Canada and the USA use an aftertreatment system (ATS) with an aftertreatment device (ATD) and Selective Catalytic Reduction (SCR) technology to reduce NOx downstream of the engine.

NOTICE

Using non-specification fluids can result in serious damage to the ATS. It is extremely important that the following guidelines be followed for vehicles with EPA10-compliant engines, or damage may occur to the ATD, and the warranty may be compromised.

- Use ultralow-sulfur diesel with 15 ppm sulfur content or less.
- Do not use fuel blended with used engine lube oil or kerosene.
- Engine lube oil must have a sulfated ash level less than 1.0 wt %; currently referred to as CJ-4 oil.
- Use only certified diesel exhaust fluid (DEF) in the DEF tank.

After exhaust gasses leave the engine, they flow into the ATS. First they flow into a two-part ATD, comprised of a diesel oxidation catalyst (DOC), and a diesel particulate filter (DPF). The DPF traps soot particles, then exhaust heat converts the soot to ash in the DPF, in a process called regeneration (regen). The harder an engine works, the better it disposes of soot. When the engine is running under load and regen occurs without input, it is called passive regen. If the engine isn't running hot enough, the electronic controls may initiate an active regen, whereby extra fuel is injected into the exhaust stream before the diesel particulate filter, to superheat the soot trapped in the filter and burn it to ash. Both types of regen occur without driver input.

⚠ WARNING

Active regeneration can occur automatically anytime the vehicle is moving. The exhaust gas temperature could reach 1500°F (800°C), which is hot enough to cause a fire, heat damage to objects or materials, or personal injury to persons near the exhaust outlet. See *Regen-Inhibit Switch* later

in this chapter for instructions on preventing automatic regen if necessary.

The exhaust temperature can remain high even after the vehicle has stopped. When stopping the vehicle shortly after an automatic regen, ensure the exhaust outlets are directed away from structures, trees, vegetation, flammable materials, and anything else that may be damaged or injured by exposure to high heat.

Operating at reduced engine load will allow soot to accumulate in the DPF. When this occurs, the DPF lamp illuminates, indicating that a regen must be performed, and the driver must either bring the vehicle up to highway speed to increase the load, or park the vehicle and initiate a parked regen. See *Parked Regen*, later in this chapter for instructions.

After the exhaust stream passes through the ATD, it flows through another canister housing the SCR device. A controlled quantity of diesel exhaust fluid (DEF) is injected into the exhaust stream, where heat converts it to ammonia (NH_3) gas. This mixture flows through the SCR device, where the ammonia gas reacts with the NOx in the exhaust, to produce harmless nitrogen (N_2) and water vapor (H_2O), which then exits out of the tailpipe.

ATS Warning Lamps

The malfunction indicator lamp (MIL) illuminates to indicate a fault that affects the emissions. See **Fig. 7.3**.

Warning lamps in the driver's message center alert the driver of situations with the aftertreatment system. A decal attached to the driver's sun visor explains the aftertreatment system DPF, HEST, and DEF warning lamps. See **Fig. 7.6**.

- An illuminated DPF lamp indicates a regen is needed.
- A slow, 10-second flashing of the HEST lamp alerts the driver that a parked regen is in progress, but the exhaust temperatures are still relatively cool. It also indicates that the high-idle speed is being controlled by the engine software, not the driver.
- A steadily illuminated HEST lamp alerts the operator of high exhaust temperatures when vehicle speed is below 5 mph (8 km/h) while it is performing an automatic regen, and during a parked regen.
- An illuminated DEF warning lamp in the gauge, indicates that the DEF tank should be refilled at the next opportunity.

Parked Regen

⚠ DANGER

During parked regeneration, exhaust temperatures are very high, and could cause a fire, heat damage to objects or materials, or personal injury to persons near the exhaust outlet.

Before initiating a parked regeneration, make certain the exhaust outlets are directed away from structures, trees, vegetation, flammable materials, and anything else that may be damaged or injured by prolonged exposure to high heat.

See **Fig. 7.7** for an explanation the ATS warnings, and actions required to avoid further engine protection sequences.

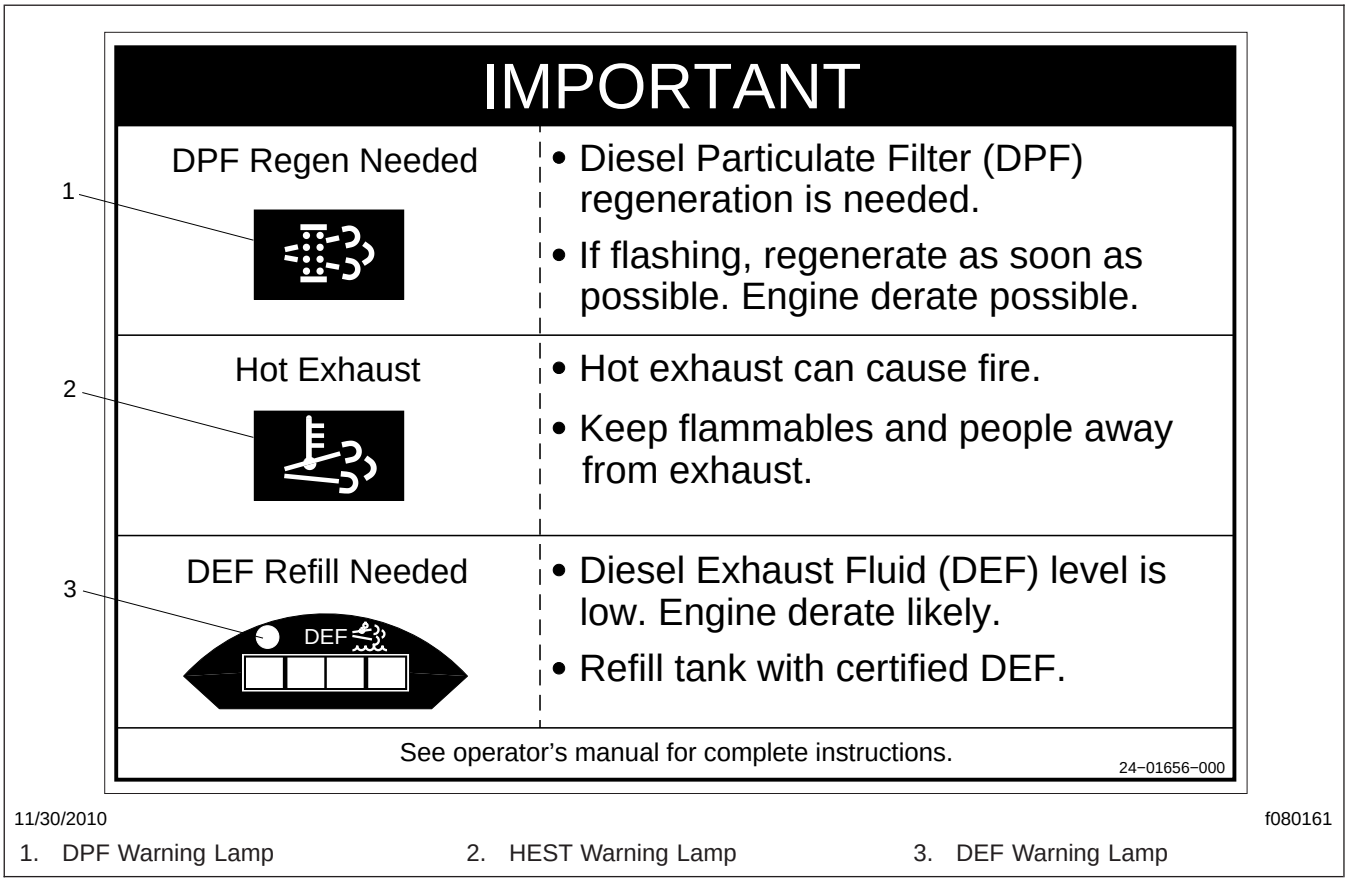
The regen switch, located on the dash, is used to initiate a parked regen of the aftertreatment device. It is a momentary switch, that you press and hold for 4 seconds to activate. See **Fig. 7.4**.

NOTE: The regen switch can initiate a parked regen only when the DPF lamp is illuminated (because the engine software is signaling for a parked regen.)

The regen-inhibit switch provides additional control over the aftertreatment regeneration process. A driver may decide to use this feature if they are hauling cargo that should not be exposed to possible high exhaust temperatures from an automatic regen. When activated, the inhibit switch will stop a regeneration cycle in progress, and prevent the start of a regeneration cycle until the switch is no longer active. See **Fig. 7.5**.

To initiate a parked regeneration, perform the following steps.

1. Park the vehicle away from all combustible and flammable materials. Chock the tires. Start and warm the engine until the coolant temperature is at least 150°F (66°C).
2. Set the parking brake. If the parking brake was already set, you must release it, then set it again.


IMPORTANT
DPF Regen Needed
• Diesel Particulate Filter (DPF) regeneration is needed.
• If flashing, regenerate as soon as possible. Engine derate possible.
Hot Exhaust
• Hot exhaust can cause fire.
• Keep flammables and people away from exhaust.
DEF Refill Needed
DEF
• Diesel Exhaust Fluid (DEF) level is low. Engine derate likely.
• Refill tank with certified DEF.
See operator's manual for complete instructions.
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1. DPF Warning Lamp
2. HEST Warning Lamp
3. DEF Warning Lamp

Fig. 7.6, Warning-Lamp Decal, Sunvisor

For manual transmissions, fully depress the clutch pedal, put the transmission in neutral, then release the pedal.

If the vehicle has a two-pedal automated transmission, shift it into gear, then back to neutral.

IMPORTANT: The driver must remain with the vehicle during the entire regen cycle.

3. Press and hold the regen switch for 4 seconds. The engine will increase rpm and initiate the regen process.
4. After the parked regen has run for 20 to 40 minutes, the regen cycle is completed. The engine idle speed will drop to normal, and the vehicle may be driven normally. The HEST lamp may be illuminated, but will go out when the vehicle speed exceeds 5 mph (8 km/h), or the system has cooled to normal operating temperature.
5. To stop a parked regen at any time during the process, engage the clutch, brake, or throttle pedal, or turn off the engine.

DPF Maintenance

Eventually ash will accumulate in the DPF and the filter will require servicing. DPF servicing must be performed by an authorized technician, following the engine manufacturer's instructions. A record must be maintained for warranty purposes, that includes:

- date of cleaning or replacement;
- vehicle mileage;
- particulate filter part number and serial number.

DEF

DEF is used in the aftertreatment system to lower NOx in the exhaust stream. DEF is colorless and

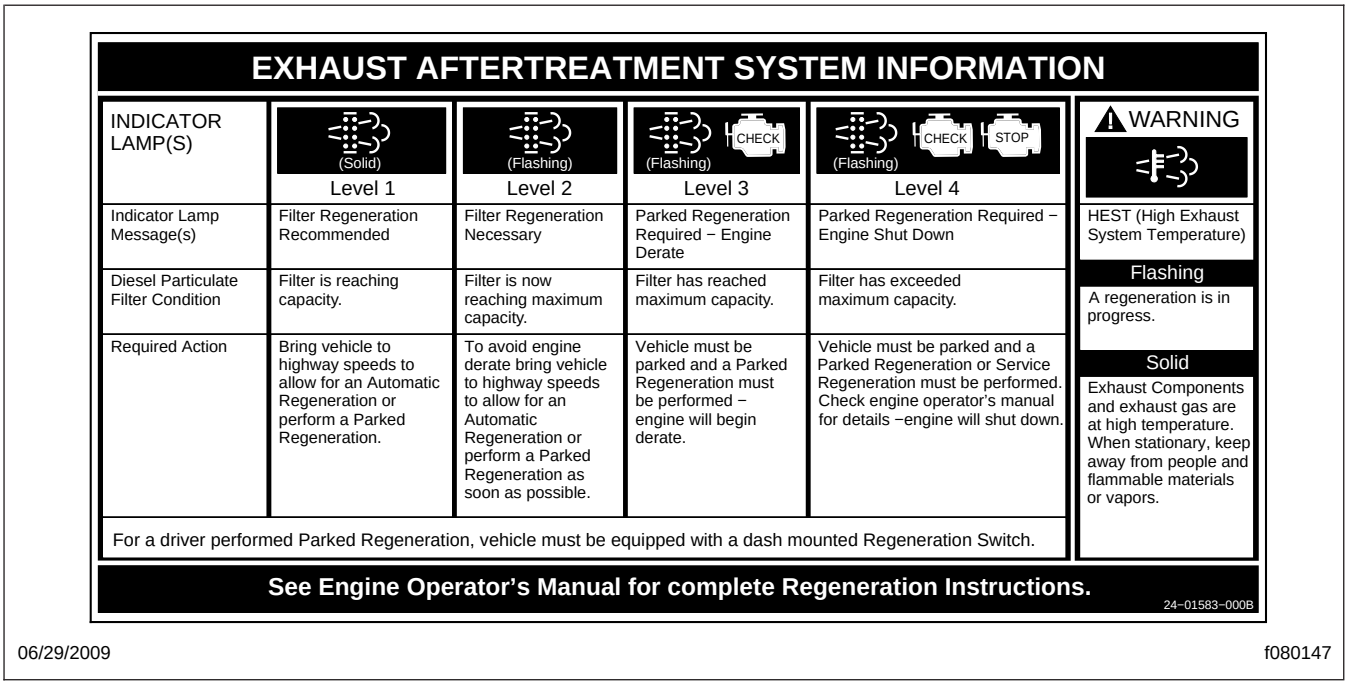
EXHAUST AFTERTREATMENT SYSTEM INFORMATION
INDICATOR LAMP(S)
(Solid)
Level 1
(Flashing)
Level 2
(Flashing) CHECK
Level 3
(Flashing) CHECK STOP
Level 4
WARNING
HEST (High Exhaust System Temperature)
Flashing
A regeneration is in progress.
Solid
Exhaust Components and exhaust gas are at high temperature. When stationary, keep away from people and flammable materials or vapors.
Indicator Lamp Message(s)
Filter Regeneration Recommended
Filter Regeneration Necessary
Parked Regeneration Required − Engine Derate
Parked Regeneration Required − Engine Shut Down
Diesel Particulate Filter Condition
Filter is reaching capacity.
Filter is now reaching maximum capacity.
Filter has reached maximum capacity.
Filter has exceeded maximum capacity.
Required Action
Bring vehicle to highway speeds to allow for an Automatic Regeneration or perform a Parked Regeneration.
To avoid engine derate bring vehicle to highway speeds to allow for an Automatic Regeneration or perform a Parked Regeneration as soon as possible.
Vehicle must be parked and a Parked Regeneration must be performed − engine will begin derate.
Vehicle must be parked and a Parked Regeneration or Service Regeneration must be performed. Check engine operator's manual for details −engine will shut down.
For a driver performed Parked Regeneration, vehicle must be equipped with a dash mounted Regeneration Switch.
See Engine Operator's Manual for complete Regeneration Instructions.
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Fig. 7.7, Exhaust-Aftertreatment Warnings

close to odorless. (It may have a slightly pungent odor similar to ammonia.) It is nontoxic, nonflammable and biodegradable. It is mildly corrosive to aluminum, but it will not affect the strength or structure of the aluminum. A white powder may be noticeable around components that the DEF comes in contact with. Around 12°F (-11°C) DEF freezes to slush, but is not damaged or destroyed if frozen, and is fully usable when thawed. The DEF supply lines are electrically heated and are purged when the engine is shut down. The DEF in the tank is allowed to freeze while the vehicle is non-operational. At start up, normal operation of the vehicle is not inhibited if the DEF is frozen; an immersion heater with engine coolant flowing through it will warm the DEF once the engine is running, to allow the SCR system to operate.

DEF Tank

EPA10-compliant vehicles are equipped with a DEF tank located on the driver's side of the vehicle, usually behind the battery box, or an optional location forward of the fuel tank for day cab configurations. See **Fig. 7.8**, and **Fig. 7.9**. The DEF tank has a 19 mm filler neck inlet that prevents the hose from a diesel outlet from being inserted, and has a blue cap for easy identification.

DEF consumption will vary depending on ambient conditions and vehicle application.

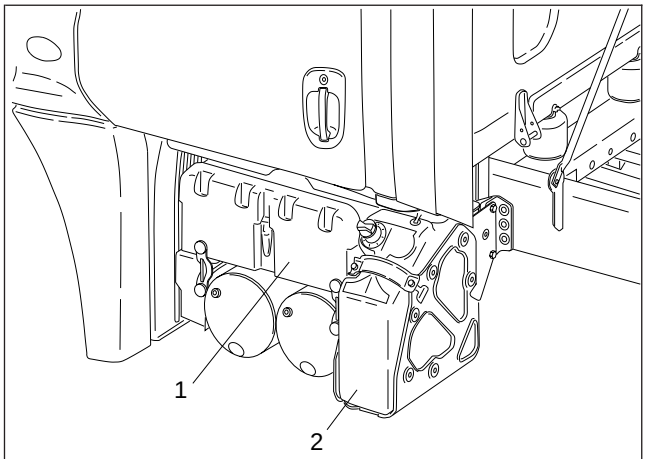
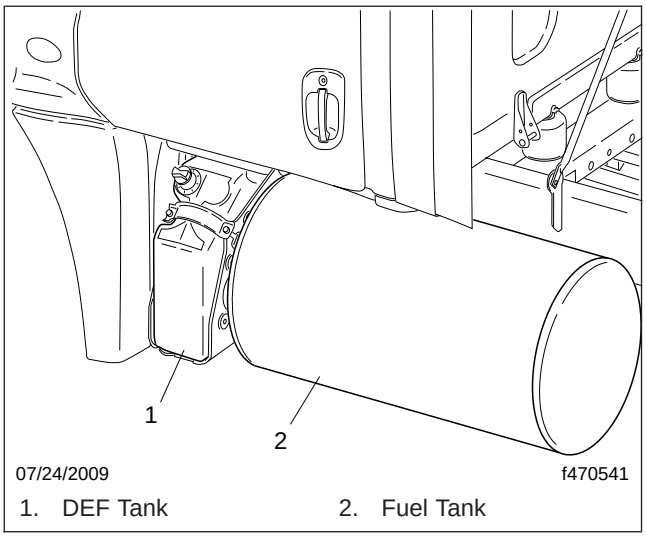


Fig. 7.8, DEF Tank Located Behind the Battery Box



1. DEF Tank
2. Fuel Tank

Fig. 7.9, DEF Tank Located Forward of the Fuel Tank

Fuel/DEF Gauge

The diesel fuel and DEF levels are measured in a dual purpose gauge. See **Fig. 7.10**.

The diesel-fuel level is indicated at the top of the gauge. Below the fuel level, a diesel-fuel warning lamp illuminates amber when the diesel fuel level drops below 1/8th of the capacity.

The lower portion of the gauge has a DEF warning lamp that illuminates amber when the DEF tank is near empty, and a lightbar that indicates the level of DEF in the tank. The DEF light bar illuminates as follows.

- Four bars illuminated green—Between 75% and 100% full.
- Three bars illuminated green—Between 50% and 75% full.
- Two bars illuminated green—Between 25% and 50% full.
- One bar illuminated green—Between approximately 10% and 25% full.
- One bar illuminated amber—DEF very low, refill DEF.
- One bar flashing red—DEF empty, refill DEF.

DEF Warnings and Engine Derates

IMPORTANT: Ignoring the DEF warning lights will result in limited engine power, with a speed limit of 5 mph (8 km/h) eventually being applied.

DEF Level Low—Initial Warning

When the DEF level reads low the following warnings strongly encourage the driver to refill the DEF tank:

- One bar of the DEF level indicator illuminates amber—DEF very low, refill DEF
- DEF warning lamp illuminates solid amber

See **Fig. 7.11**.

The DEF tank must be filled to cancel the warning sequence.

DEF Empty

When the DEF level reads empty, the following warnings are activated:

- One bar of the DEF level indicator flashes red—DEF empty, refill DEF
- DEF warning lamp flashes amber
- MIL lamp illuminates
- CHECK engine lamp illuminates for Cummins ISB and ISC/L engines

Detroit Diesel engines: Power is limited, with a 55 mph (90 km/h) speed limit.

Cummins engines: Power is limited with progressively harsher engine power limits applied.

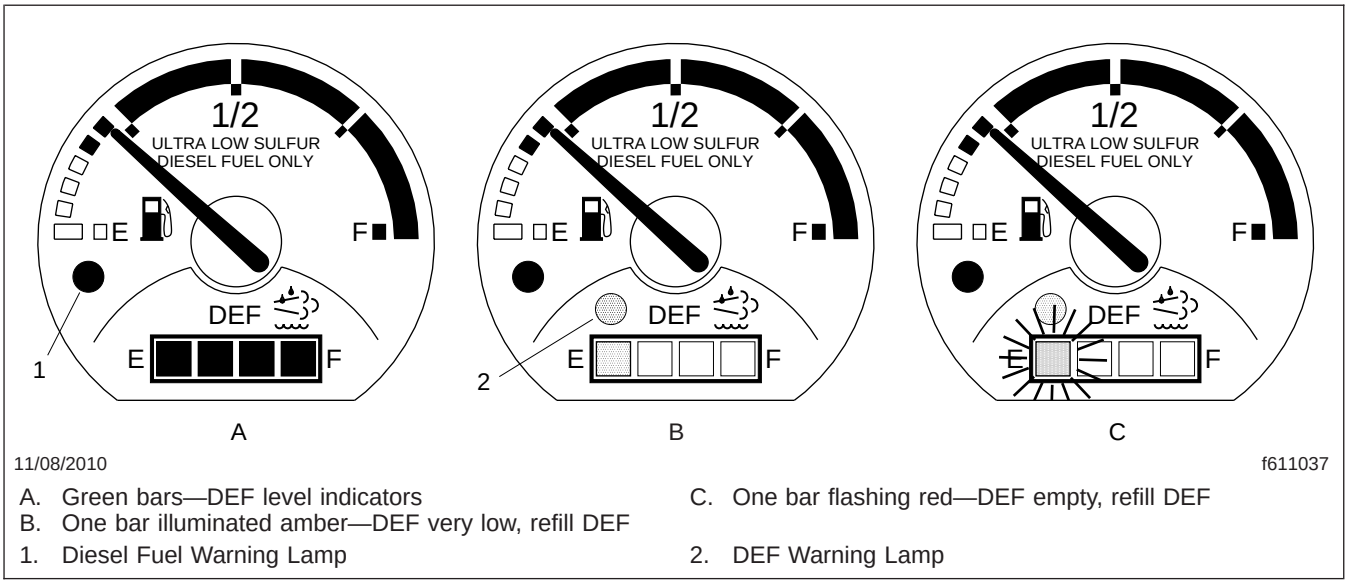
See **Fig. 7.12**.

The DEF tank must be filled to cancel the warning sequence.

DEF Level Empty and Ignored

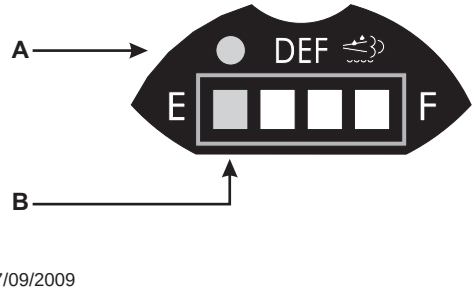
If the empty warning is ignored and the DEF is not refilled, the red STOP engine lamp illuminates in addition to the DEF warning lamp, MIL, (and CHECK engine lamp if Cummins ISB or ISC/L engine.) See **Fig. 7.13**.

If the DEF is not refilled, a 5 mph (8 km/h) speed limit will be applied after the next engine shut down or while parked and idling.



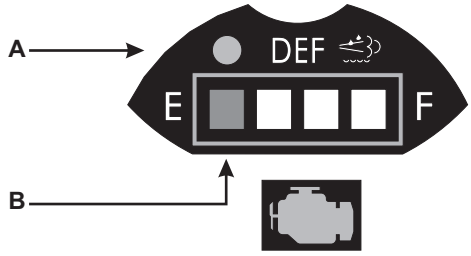
A. Green bars—DEF level indicators
B. One bar illuminated amber—DEF very low, refill DEF
C. One bar flashing red—DEF empty, refill DEF
1. Diesel Fuel Warning Lamp
2. DEF Warning Lamp

Fig. 7.10, Fuel/DEF Gauge



A. DEF Warning Lamp (illuminated)
B. DEF Lightbar (one bar amber)

Fig. 7.11, DEF Level Low Initial Warning



NOTE: MIL illuminates. CHECK engine lamp illuminates if Cummins ISB or ISC/L engine. Engine power is limited.

A. DEF Warning Lamp (flashing)
B. DEF Lightbar (one bar flashing red)

Fig. 7.12, DEF Empty Warning

DEF Quality or SCR Tampering

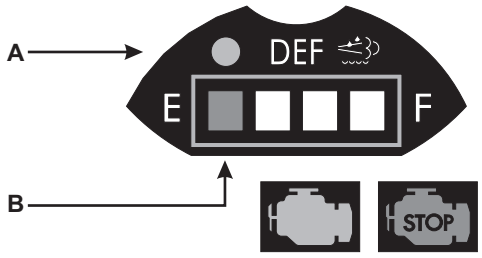
NOTICE

Once contaminated DEF or tampering has been detected in the SCR system, the vehicle must be taken to an authorized service center to check the SCR system for damage, and to deactivate the warning lights and engine limits.

If contaminated DEF or tampering is detected the DEF warning light flashes, and the MIL illuminates to warn the driver. The CHECK engine lamp also illuminates if the vehicle has a Cummins ISB or ISC/L engine. See **Fig. 7.13**.

Detroit Diesel engines: Power is limited, with a 55 mph (90 km/h) speed limit. If the fault is not corrected the STOP engine light illuminates, and a 5 mph (8 km/h) speed limit will be applied after the next engine shut down, or while parked and idling.

Cummins engines: Power is limited with progressively harsher engine power limits applied. If the fault is not corrected the STOP engine light illuminates, and a 5 mph (8 km/h) speed limit will be applied after the next engine shut down, or while parked and idling.



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NOTE: STOP engine light illuminates. Engine power limited, speed limit of 5 mph (8 km/h)

A. DEF Warning Lamp (flashing)
B. DEF Lightbar (one bar flashing red)

Fig. 7.13, DEF Empty and Ignored Warning

Engine Starting

For cold-weather starting, refer to "Cold Weather Starting" later in this chapter.

Whenever you start an engine, watch for any signs of engine problems. If the engine vibrates, misfires, or makes unusual noises, turn the engine off as soon as possible and determine the cause of the problem. Frequently, engine damage may be avoided by a quick response to early indications of problems.

NOTICE

When starting a vehicle equipped with a manual transmission and clutch lockout switch, the clutch pedal must be fully depressed during the entire start sequence. Failure to do so can cause the pinion to release and re-engage, which could cause ring gear and starter pinion damage.

If a vehicle does not start on the first attempt, make sure that the engine has completely stopped rotating before reapplying the starter switch. Failure to do so can cause the pinion to release and re-engage, which could cause ring gear and starter pinion damage.

Moving a vehicle with the starter and/or using the starter to bump the engine for maintenance procedures is strictly prohibited. Use of these methods to bump the engine over or move the vehicle can cause the pinion to release and re-engage, which could cause ring gear and starter pinion damage.

Ring gear and starter pinion damage caused by improper starting procedures is not warrantable.

Pre-Start

NOTE: These pre-start steps apply to all engines.

1. Perform the engine pretrip inspection and daily maintenance checks in **Chapter 11**.
2. Set the parking brake.
3. For manual transmissions, place the transmission in neutral and disengage the clutch.

   For automatic transmissions, make sure the transmission shift control is in neutral or park.

NOTE: On vehicles equipped with a neutral start switch, the transmission must be in neutral before the engine can be started. For air start systems, check the air supply before starting the engine. There must be 100 psi (689 kPa) of air pressure available.

4. Turn the ignition switch to the ON position (**Fig. 7.14**). All the electronic gauges on the ICU (instrumentation control unit) complete a full sweep of their dials, the warning and indicator lights light up, and the buzzer sounds for three seconds.

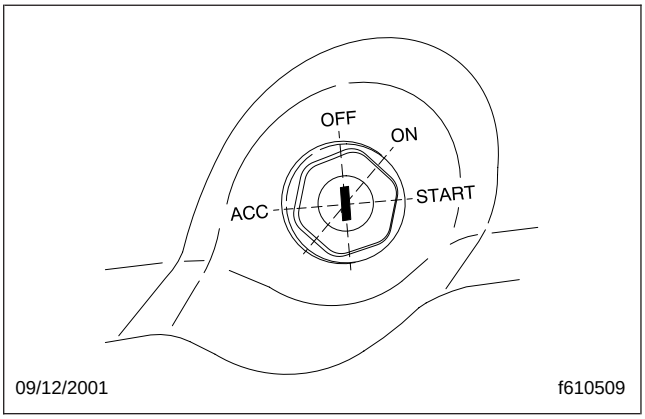

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Fig. 7.14, Ignition Switch Positions

Starting Precautions, All Engines

⚠ WARNING

Never pour fuel or other flammable liquid into the air inlet opening in the air intake in an attempt to start the vehicle. This could result in a flash fire causing serious personal injury or property damage.

NOTICE

Do not crank the engine for more than 30 seconds at a time. Wait two minutes after each try to allow the starter to cool. Failure to do so could cause starter damage.

NOTE: Some starters are equipped with optional overcrank protection. If overcranking occurs, a thermostat breaks the electrical circuit to the starter motor until the motor has cooled.

NOTICE

Protect the turbocharger during the start-up by not opening the throttle or accelerating the engine above 1000 rpm until minimum engine idle oil pressure registers on the gauge. Failure to do so could damage the turbocharger.

Cold-Weather Starting

Electronic engines do not normally require special starting aids. At low temperatures, oil pan heaters or water jacket heaters are sometimes used to assist in starting. See the engine manufacturer's operation manual for starting aids that are approved for specific engines.

Starting After Extended Shutdown or Oil Change

An engine in storage for an extended period of time (over winter, for example) may accumulate water in the oil pan through normal condensation of moisture on the internal surfaces of the engine. Oil diluted by water cannot provide adequate bearing protection at start-up. For this reason, change the engine oil and filters after extended storage.

NOTICE

Failure to eliminate water-diluted lubricating oil may lead to serious engine damage at startup.

Before engine start-up, complete the engine pretrip and post-trip inspections and maintenance procedures in **Chapter 11**.

Engine Break-In

Every engine is tested on a dynamometer before shipment, eliminating the need for a break-in period. Before running the engine for the first time, follow the instructions in the engine manufacturer's operation manual.

Engine Operation

⚠ DANGER

Do not operate the engine in an area where flammable vapors such as gasoline or diesel fumes are present. Shut down the engine when in an area where flammable liquids or gases are being handled. Failure to observe these precautions could result in serious injury or death.

All Freightliner diesel engines comply with the requirements of the Federal (U.S.) Clean Air Act. Once an engine is placed in service, the responsibility for meeting both state and local regulations is with the owner/operator.

IMPORTANT: EPA07 and EPA10 emissions regulations apply to vehicles domiciled in Canada and the USA at the time of printing this manual. Vehicles that are domiciled outside of the USA and Canada may not have EPA07- or EPA10-compliant engines with an emission aftertreatment system, depending upon local statutory emissions guidelines.

NOTICE

It is extremely important that the following points be followed for vehicles with EPA07- or EPA10-compliant engines, or damage may occur to the aftertreatment device, and the warranty may be compromised.

- Use ultralow-sulfur diesel with 15 ppm sulfur content or less.
- Do not use fuel blended with used engine lube oil or kerosene.
- Engine lube oil must have a sulfated ash level less than 1.0 wt %; currently referred to as CJ-4 oil.
- Adequate maintenance of the engine and the diesel-particulate filter are the responsibility of the owner/operator, and are essential to keep the emission levels low. Good operating practices, regular maintenance, and correct adjustments are factors that will help to stay within the regulations.

The driver should be familiar with the vehicle warning system in order to bring the vehicle to a safe stop if the engine malfunctions. If the driver doesn't understand how the warning system works, an engine shutdown could occur, causing a safety hazard. See **Chapter 3** for information.

All engines have an operating range specific to that engine in which the engine performs most efficiently. The operating range extends from maximum torque rpm at the low end to engine rated speed at the high end. Most engines deliver best fuel economy when operated in the low- and mid-speed segments of the efficiency range and produce maximum horsepower at rated speed, which is also the recommended maximum speed of the engine. For specifics for any engine refer to the engine manufacturer's operation manual.

Prolonged idling of engines is not recommended, and is illegal in some states. The belief that idling a diesel engine causes no engine damage is wrong. Idling produces sulfuric acid, that is absorbed by the lubricating oil, and eats into bearings, rings, valve stems, and engine surfaces. If you must idle the engine for cab heat or cooling, the high idle function of the cruise control switches should be used. An idle speed of 900 rpm should be enough to provide cab heat in above freezing ambient temperatures.

If the engine is programmed with the idle shutdown timer, ninety seconds before the preset shutdown time, the CHECK ENGINE light will begin to flash at a rapid rate. If the position of the clutch pedal or service brake changes during this final ninety seconds (CHECK ENGINE lamp flashing) the idle shutdown timer will be disabled until reset.

Cruise Control

⚠ WARNING

Do not use the cruise control system when driving conditions do not permit maintaining a constant speed, such as in heavy traffic or on roads that are winding, icy, snow-covered, slippery, or roads with a loose driving surface. Failure to follow this precaution could cause a collision or loss of vehicle control, possibly resulting in personal injury or property damage.

Dash-Mounted Switches

NOTICE

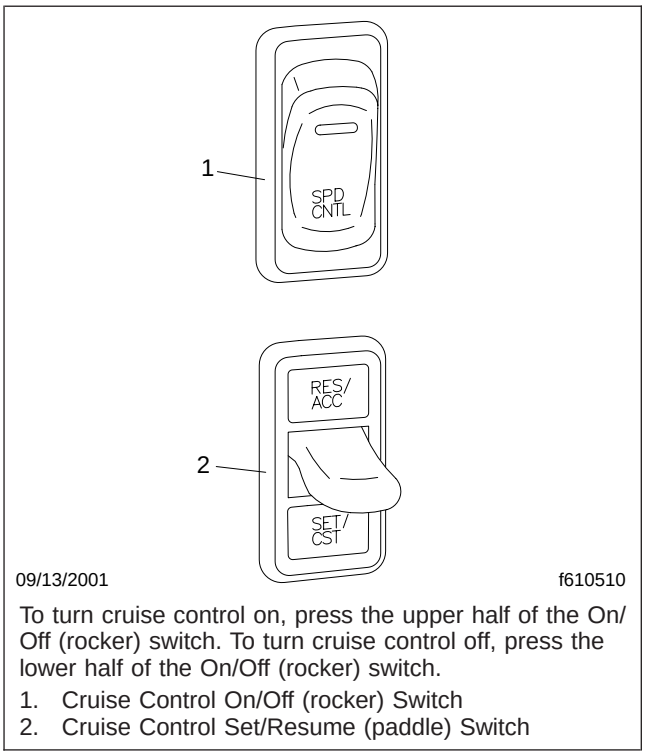
Do not attempt to shift gears without using the clutch pedal when the cruise control is engaged. Failure to follow this precaution will result in a temporarily uncontrolled increase in engine speed; transmission damage and gear stripping could result.

On standard models, cruise control is activated by two dash switches (**Fig. 7.15**).

- The On/Off Switch—this two-position rocker switch bears the legend SPD CNTL on the lower half of the switch. When cruise control is on, an amber light illuminates in the top part of the switch.
- The Set/Resume Switch—this three-position paddle switch bears the legend RES/ACC above the paddle and SET/CST below the paddle.

1. To cruise at a particular speed, do these steps:
   - 1.1 Press the upper half of the On/Off (rocker) switch on the instrument panel.
   - 1.2 Hold the accelerator pedal down until the speedometer reaches the desired speed.
   - 1.3 Momentarily lower the paddle of the Set/Resume switch to SET/CST.
2. To disengage the cruise control, do these steps:
   - 2.1 Press down the brake pedal (on automatic or manual transmission) *or*

     Press down the clutch pedal (on manual transmission only)



To turn cruise control on, press the upper half of the On/Off (rocker) switch. To turn cruise control off, press the lower half of the On/Off (rocker) switch.

1. Cruise Control On/Off (rocker) Switch
2. Cruise Control Set/Resume (paddle) Switch

Fig. 7.15, Cruise Control Switches, Dash-Mounted

2.2 Press the lower half of the On/Off (rocker) switch on the instrument panel.

3. To resume a preselected cruise speed, do these steps:

3.1 If the On/Off (rocker) switch on the instrument panel is off, turn it on.

3.2 Momentarily raise the paddle of the Set/Resume switch to RES/ACC. Cruise will return to the last speed selected.

NOTE: If the ignition is shut off, the speed memory will be lost.

4. To adjust cruise speed up, raise the paddle of the Set/Resume switch to RES/ACC and hold it there until the vehicle accelerates to the new speed, as desired.

5. To adjust cruise speed down, lower the paddle of the Set/Resume switch to SET/CST and hold it there until the vehicle decelerates to the new speed, as desired.

Shift Knob Controls, Optional

Cruise control can also be activated by the optional PAUSE, RESUME, and SET buttons on the transmission shift knob (**Fig. 7.16**).

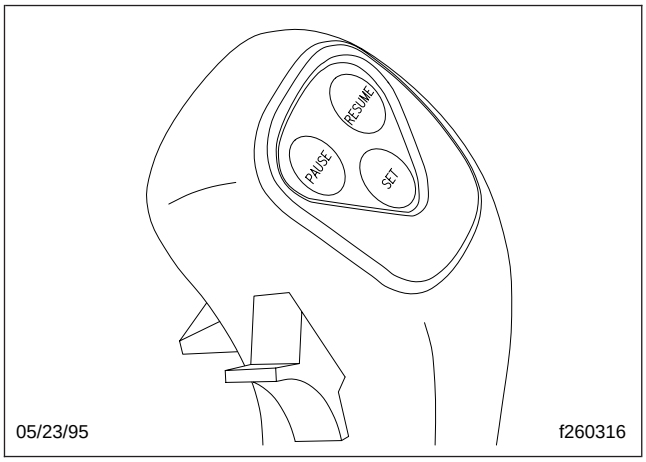


Fig. 7.16, Cruise Control Buttons on the Transmission Shift Knob

1. To cruise at a particular speed, do these steps:

1.1 Hold the accelerator pedal down until the speedometer reaches the desired speed.

1.2 Push the SET button on the transmission shift knob.

2. To disengage the cruise control, do these steps:

2.1 Press down the brake pedal (on automatic and manual transmission) *or*

Press down the clutch pedal (on manual transmission only)

2.2 Push the PAUSE button on the transmission shift knob.

3. To resume a preselected cruise speed, push the RESUME button on the transmission shift knob. Cruise will return to the last speed selected.

NOTE: If the ignition is shut off, the speed memory will be lost.

4. To adjust cruise speed up, push the SET button and hold it in until the vehicle accelerates to the new speed, as desired.

5. To adjust cruise speed down, push the RESUME button and hold it in until the vehicle decelerates to the new speed, as desired.

Power Takeoff (PTO) Governor

Front Engine Power Take Offs (PTO) are devices used to tap into engine power to run auxiliary devices. Common uses are vehicles with hydraulic pumps which power additional equipment. The following instructions are general guidelines for operating a PTO.

1. Set the parking brake. Shift the transmission to neutral.
2. Press the dash PTO switch. Release the switch when the light begins to blink.

   When the light comes on steadily, the PTO is engaged and ready to operate. In stationary mode, the vehicle must remain in neutral with the parking brake set.
3. To activate the mobile mode, shift from neutral to reverse, 1st, or 2nd gear. The clutch will open and the PTO will disengage for a moment.
4. Touch the throttle pedal to close the clutch and engage the PTO in mobile mode. The PTO may be operated with the transmission in the following gears only: R-N-1-2.

NOTE: Do not attempt to change gears while the vehicle is moving. The transmission will ignore the request.

5. To end the mobile mode, bring the vehicle to a stop. The clutch will open and shut off power to the PTO.
6. To resume stationary mode, shift to neutral. The PTO will engage.
7. To end stationary mode, press the dash switch. When the light in the switch goes out, power to the PTO is shut off. Shut down the engine.

Cold-Weather Operation

Satisfactory performance of a diesel engine operating in low ambient temperatures requires modification of the engine, surrounding equipment, operating practices, and maintenance procedures. The lower the temperature, the greater the amount of modification required. For service products approved for use in cold weather for your engine, see the engine manufacturer's engine operation manual, supplied in the vehicle documentation package.

If satisfactory engine temperature is not maintained, maintenance costs will increase due to greater engine wear. If the engine coolant temperature becomes too low, raw fuel will wash the lubricating oil off the cylinder walls and dilute the crankcase oil, causing all moving parts of the engine to suffer from poor lubrication.

If the engine is in good mechanical condition and the precautions necessary for cold-weather operation are taken, ordinary cold weather will not cause difficulty in starting, or loss of efficiency.

The following points are important to observe when operating in cold weather:

- Check for cracks in the batteries, for corrosion of the terminals, and for tightness of the cable clamps at the terminals.
- Charge the batteries to full capacity. Replace any battery that is damaged.
- If so equipped, turn off the load disconnect switch after the engine is shut down, to prevent battery discharge.
- Have the alternator output checked at an authorized service provider.
- Check the condition and tension of the drive belts.
- Refer to the engine manufacturer's engine operation manual for recommended heaters, low-viscosity lubricating oils, wintergrade fuels, and approved coolants.

A winterfront may be used to improve cab heating while idling. If a winterfront is used, at least 25% of the grille opening should remain open in sectioned stripes that run perpendicular to the charge-air-cooler tube-flow dirrection. This assures even cooling across each tube, and reduces header to tube stress, and possible failure. Winterfronts should only be used when the ambient temperature remains below 10°F (-12°C).

High-Altitude Operation

Engines lose horsepower when operated at high altitude because the air is too thin to burn as much fuel as at sea level. This loss is about three percent for

each 1000 feet (300 m) altitude above sea level for a naturally aspirated engine.

All engines used on M2 vehicles are altitude-compensated by the use of a turbocharger. This reduces smoky exhaust at high altitudes, requires less downshifting, and allows the engine to make better use of its fuel. Nevertheless, shift gears as needed to avoid excessive exhaust smoke.

Engine Shutdown

1. With the vehicle stopped, apply the parking brakes and place the transmission in neutral.

NOTICE

Idle the engine one to two minutes before shutting it down. After hard operation, shutting down the engine without idling may cause damage to the turbocharger.

2. Allow the engine to idle one to two minutes before shutting it down. This allows the lubricating oil and the coolant to carry heat away from the combustion chambers, bearings, shafts, and seals. The extreme heat may cause bearings to seize or oil seals to leak.

IMPORTANT: Bearings and seals in the turbocharger are subjected to the high heat of combustion exhaust gases. While the engine is running, this heat is carried away by oil circulation, but if the engine is stopped suddenly, the turbocharger temperature may rise as much as 115°F (46°C).

NOTICE

Except in an emergency, do not shut down the engine when the coolant temperature is above 194°F (90°C). To do so could damage the engine.

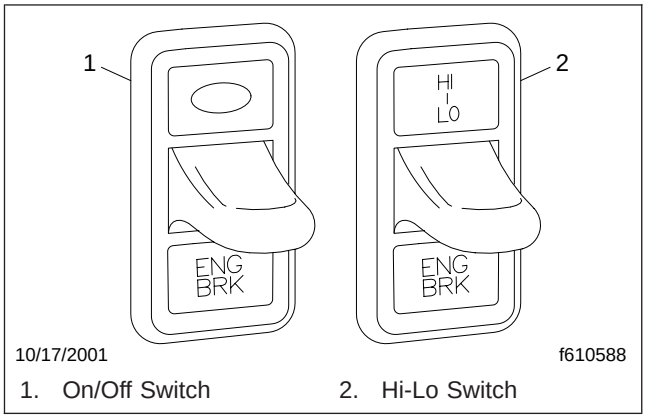
3. Turn off the ignition switch and shut down the engine.

Engine Braking

The engine brake switch controls the degree of engine braking. Normally there are two paddle switches, a two-position On/Off Switch to activate the engine brake, and a two-position HI-LO Switch to control the amount of engine braking.

To turn the two-position On/Off Switch on, raise the paddle. When the two-position switch is on, an amber LED (light-emitting diode) illuminates inside the switch.

To turn the two-position HI-LO Switch on high, raise the paddle (at the HI-LO legend). To turn the two-position HI-LO Switch on low, lower the paddle (at the ENG BRK legend). See **Fig. 7.17**.



1. On/Off Switch 2. Hi-Lo Switch

Fig. 7.17, Engine Brake Switches

When the panel lights are on, the Hi-Lo legend is backlit in amber on the three-position switch. On both the three-position switch and the two-position switch, the ENG BRK legend is backlit in green when the panel lights are on.

Whenever vehicle braking is required on good road conditions, the engine brake may be used in conjunction with the service brakes. There is no time limit for operation of the engine brake. However, an engine brake does not provide the precise control available from the service brakes, and is not a substitute for a service braking system.

⚠ WARNING

Usage of the engine brake as the primary braking system can cause unpredictable stopping distances, that could result in personal injury or property damage. Service brakes are the primary vehicle braking system.

Since the engine brake is most effective at rated engine speed, gear selection is very important. Gearing down the vehicle, within the limits of the rated engine

speed, makes the engine brake more effective. Recommended engine braking speed is above 1800 rpm and below the rated speed.

⚠ WARNING

The engine brake must be disengaged when shifting gears using the clutch pedal. If the engine brake is engaged when the transmission is in neutral, the braking power of the engine brake can stall the engine, which could result in loss of vehicle control, possibly causing personal injury and property damage.

NOTICE

Do not allow the engine to exceed 2500 rpm. Serious engine damage could result.

"Control speed" is the speed at which the engine brake performs 100 percent of the required downhill braking, resulting in a constant speed of descent. The control speed varies, depending on vehicle weight and the downhill grade.

For faster descent, select a higher gear than that used for control speed. Service brakes must then be used intermittently to prevent engine overspeed and to maintain desired vehicle speed.

A driver may descend slower than control speed by selecting a lower gear, being careful not to overspeed the engine. Occasional deactivation of the engine brake may be necessary to maintain the designated road speed under these conditions.

Below a set engine temperature when the engine is cold, the brake may be disabled depending on the brake type.

To activate the engine brake after the engine is warmed up and the vehicle is in motion:

- Remove your feet from both the clutch and throttle pedals. Press the dash-mounted ENG BRK switch to toggle the engine brake ON.

  The engine brake will engage at the rate last set on the brake intensity switch.

- Move the intensity switch to the desired intensity. Depending on engine model, LO will provide 1/3 or 1/2 of the full braking capacity of the engine. HI will provide maximum engine braking.

  Use the dash-mounted switch set at the LO position when driving on flat, open stretches of road. If the service brakes are still required to slow down on a grade, switch to a higher setting on the dash switch, until there is no need for the service brakes. Grade descent speed should be such that the service brakes are used infrequently and that they remain cool, thus retaining their effectiveness.

- For maximum retarding, maintain the top governed speed of the engine through the appropriate selection of gears. When shifting gears, the engine brake will disengage when the clutch pedal is depressed, then engage when the clutch pedal is released.

- To cancel the engine brake application, toggle the ENG BRK switch OFF.

If the engine is equipped with both cruise control and an engine brake, the engine brake can operate automatically while in cruise control mode. If the cruise control/engine brake function is turned on in the DDEC VI system programming, the engine brake will come on "low" when the set road speed increases a few miles-per-hour (kilometers-per-hour) above the cruise set speed. The maximum amount of braking (low, medium, high) is selected with the dash switches. When the vehicle returns to the set cruise speed, the engine brake will turn off.

The engine brake will only operate when the accelerator pedal is fully released. Disengaging the clutch will prevent the engine brake from operating.

Vehicles equipped with antilock braking systems (ABS) have the ability to turn the engine brake off if a wheel-slip condition is detected. The engine brake will automatically turn itself back on once the wheel slip is no longer detected. The DDEC VI system will deactivate the engine brake system when the engine speed falls below 1000 rpm or when the vehicle slows down to a preset speed, depending on DDEC programming. This prevents stalling the engine.

Exhaust Braking Systems

Exhaust Brake Switch

The optional exhaust brake is controlled by a dash-mounted rocker switch to help slow the vehicle when the accelerator is released.

To turn the exhaust brake on, press on the upper part of the rocker (at the light inside the switch). The exhaust brake turns off automatically. See **Fig. 7.18** or **Fig. 7.19**.

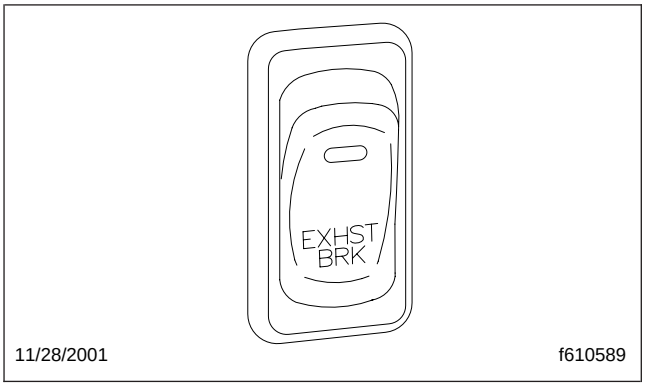


Fig. 7.18, Exhaust Brake Switch

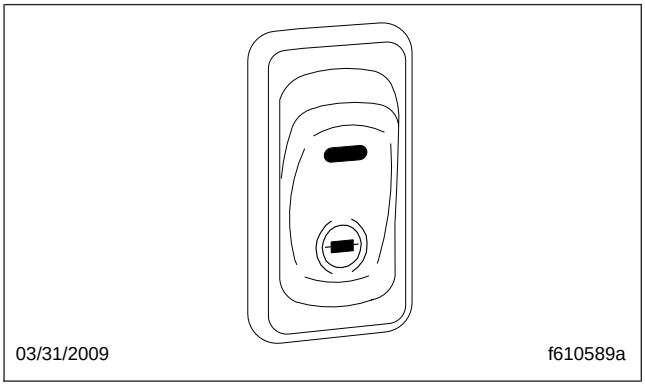


Fig. 7.19, Exhaust Brake Switch

When the exhaust brake switch is on, an amber LED illuminates inside the switch. When the panel lights are on, the EXHST BRK legend is backlit in green.

Mercedes-Benz Exhaust Brake

An exhaust brake is an optional auxiliary braking system that assists but does not replace the service brake system. The exhaust brake can be used alone or together with the constant-throttle valves for steep or long grades. The exhaust brake switch located on the control panel, in combination with the accelerator and clutch pedals, allows the driver to make maximum use of the exhaust brake in off-highway and mountain driving as well as in traffic or high-speed highway driving.

When only the exhaust brake is installed, a two-position switch on the dash controls the engine braking system. The exhaust brake is only active when the engine speed is between 1100 and 2700 rpm. Depressing the accelerator or clutch pedal deactivates the exhaust brake. The ABS system, when active, also deactivates the exhaust brake.

The exhaust brake is a butterfly valve mounted in the exhaust pipe. When the driver's foot is not on the accelerator pedal and the upper half of the exhaust brake switch is pressed in, with the amber light on the switch illuminated, an air cylinder shuts the butterfly valve, which restricts the flow of exhaust gases and retards the engine. This retarding action is carried through the engine and drivetrain, slowing the vehicle and reducing the need for frequent service brake applications.

Exhaust brakes are not intended for use as the primary braking system during vehicle operation.

Operating Characteristics

⚠ WARNING

Do not use the exhaust brake when driving on slippery or low-traction road surfaces. Failure to follow this precaution could result in a loss of vehicle control and possible personal injury or property damage.

Before starting the engine, make sure that the lower half of the exhaust brake switch is pressed in and the amber light is not illuminated. Do not turn the exhaust brake on until the engine has reached normal operating temperatures.

When you remove your feet from both the accelerator and clutch pedals and the upper half of the exhaust brake switch is pressed in with the amber light illuminated, the exhaust brake is applied. The following conditions should exist if the brake is operating properly:

- A slight change in the sound of the engine may be noticed when the exhaust brake is applied.
- Exhaust smoke should appear normal.
- Engine temperature should remain in the normal operating range.
- Road speed usually decreases when the exhaust brake is applied during a descent. When the vehicle is carrying a heavy load or the

grade is extremely steep, you may need to apply the service brakes occasionally.

- Do not expect a retarding effect similar to sudden hard application of the service brakes. The exhaust brake retards the vehicle with a smooth braking effect.
- During a descent, the tachometer usually shows a drop in rpm, depending on the grade and the vehicle load.
- Depending on the grade and vehicle load, you may or may not feel the retarding force acting against your body when the brake is applied. The retarding force of the brake may not always be noticed, but it is actually preventing the vehicle from going much faster.

Make sure the exhaust brake is turned off before shutting down the engine.

Driving Downhill

While approaching a steep grade, make sure that the upper half of the exhaust brake switch is pressed in, with the amber light illuminated. The exhaust brake comes on as soon as you remove your foot from the accelerator pedal. While going down the grade, use a low enough gear to safely descend with a minimum application of the service brakes. As a general guideline, use the same gear as you would to ascend the hill.

NOTICE

Do not allow the engine to exceed its governed speed, or serious engine damage could result.

Apply the service brakes to reduce the engine rpm or make a slower descent by using a lower gear.

Pacbrake® Exhaust Brake

The Pacbrake exhaust brake is intended as a supplement to the service brakes and will *not* bring the vehicle to a complete stop. The Pacbrake will assist in the control or reduction of road speed in conjunction with, or independent of, the service brakes. The amount of retarding or braking force is controlled by the driver.

Pacbrake Operation (Caterpillar)

The Pacbrake is controlled by the exhaust brake switch and the throttle pedal. All applications are additionally affected, controlled, or governed by engine speed through transmission gear selection. The Allison MD3060 transmission has automatic downshifting when the exhaust brake is requested. See the information on the "Allison World Transmission" later in this chapter.

On some applications, when the Pacbrake is in use, it may be necessary to check that the cruise control is not set and that the throttle is in the idle position.

On some applications, the engine, transmission, cruise control, and the Pacbrake exhaust brake may electronically interact with each other, which automatically operates their functions. Following are some examples of the programmed options that may be available with the cruise control in the on position:

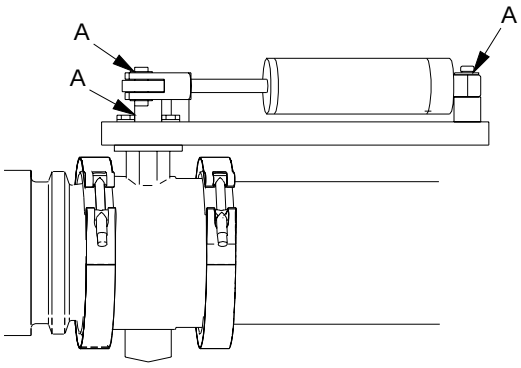
- The coast mode engages the Pacbrake when the service brake is applied and disengages when the service brake is released.
- The latch mode engages the Pacbrake when the service brake is applied and the Pacbrake remains on after the service brake is released. The Pacbrake is disengaged when another input (depressing the throttle or clutch, engine speed drops below 800 rpm, or the exhaust brake switch is turned off) is supplied.
- The manual mode does not require the cruise control switch to be on, and operates the Pacbrake manually at the driver's discretion.

The amount of braking power the engine will develop is related to the speed (rpm) of the engine. The higher the engine rpm, the greater the retarding power.

Certain conditions may require that the transmission be downshifted in order to generate adequate rpm for the amount of retarding power required. Pacbrake exhaust brakes are designed and approved for safe use at 300 rpm above the engine's maximum governed rpm. Refer to individual engine manufacturer's specifications.

The Pacbrake will function best if it is used all of the time. However, if the vehicle is used inconsistently or seasonally, it may be necessary to perform a preventive maintenance procedure.

1. With the engine shut down, use any oil-free or nonpetroleum-based high-heat lubricant, and spray or coat a sufficient amount on the restricter valve shaft and the attaching locations at each end of the actuation cylinder. See **Fig. 7.20**.



A. Lubrication Point

Fig. 7.20, Pacbrake Exhaust Brake and Air Cylinder

2. With your hands or a pair of pliers, motion the valve several times to distribute the lubricant down the shaft and the attaching locations.

NOTE: Starting the engine and idling for short periods of time is not recommended. During a cold engine start-up, enough moisture is developed within the engine and the exhaust system to create a corrosion hazard that could affect the future operation of the Pacbrake. The brake housing may trap water in the valve shaft bore causing corrosion in an improperly functioning or nonfunctioning brake. If it is necessary to periodically start the engine, it is recommended that normal operating temperatures be attained before shutting down the engine.

Allison World Transmission

Pacbrake exhaust brakes on engines that are used with the Allison World Transmission MD series, are interfaced with the transmission electronic control module (ECM). An exhaust-brake-enabled transmission ECM will usually provide converter lockup in gears two through six. Effective exhaust braking begins when the transmission automatically downshifts into fifth gear (62 mph or less). Once on, the Pacbrake exhaust brake will control road speed and/or slow the vehicle sufficiently that the transmission will automatically downshift, if necessary, to Allison's preselect mode.

The preselect mode is normally assigned to second gear; however, the transmission can be reprogrammed by an Allison Transmission Distributor to third or fourth gear, should the operator desire. If additional retarding power is required before the automatic downshifting occurs, you can select a lower transmission gear on the Allison shift selector.

8

Drivetrain

Clutches 8.1
Allison On-Highway Transmissions 8.3
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Clutches

Clutch Operation

Applying the Clutch Brake

The purpose of the clutch brake is to stop the transmission gears from rotating in order to engage the transmission gears quickly in making an initial start. To apply the clutch brake, put the transmission in neutral and press the clutch pedal to the floor.

⚠ CAUTION

Never apply the clutch brake while the vehicle is moving. The clutch pedal should never be pressed down fully before putting the transmission in neutral. Considerable heat will be generated, which will be detrimental to the friction discs, release bearings, and transmission front bearings.

Applying the clutch brake with the transmission still in gear puts a reverse load on the gear. At the same time, it will have the effect of trying to stop or decelerate the vehicle with the clutch brake. Rapid wear of friction discs will take place necessitating frequent replacement.

Vehicle Overload, or Overloading the Clutch

⚠ CAUTION

Overloading will not only result in damage to the clutch, but also to the entire powertrain.

Clutches are designed for specific vehicle applications and loads. These limitations should not be exceeded.

Riding the Clutch Pedal

Riding the clutch pedal is destructive to the clutch. Partial clutch engagement permits slippage, and generates excessive heat. Riding the clutch pedal will also put a constant thrust load on the release bearing, which can thin out the lubricant. Release bearing failures can be attributed to this type of misuse.

Holding the Vehicle on an Incline With a Slipping Clutch

A slipping clutch accumulates heat faster than it can be dissipated, resulting in early clutch failures. Never use the clutch to hold a vehicle on a hill.

Coasting With the Clutch Released (pedal down) and the Transmission in Gear

⚠ WARNING

Do not coast with the clutch released (pedal depressed) and the transmission in gear. High driven-disc rpm could cause the clutch facing to be thrown off the disc. Flying debris could cause injury to persons in the cab.

If the transmission remains in a low gear and the vehicle gains speed, as may occur on a downgrade, the input shaft and clutch driven disc will turn at speeds that are higher than normal. This occurs because the rear wheels and the driveline become the input for the transmission, and a higher-than-normal speed for a given transmission gear translates to a higher rpm value for the clutch driven disc.

Clutch driven discs are designed to allow for some amount of excess rotational speed, but the facing has a limited burst strength. If the clutch driven disc rpm increases too much, the clutch facing can be thrown off the disc(s).

Engaging the Clutch While Coasting

Engaging the clutch while coasting can result in tremendous shock loads and possible damage to the clutch as well as to the entire drivetrain.

Report Erratic Clutch Operation Promptly

Reporting erratic clutch operation as soon as possible will give maintenance personnel a chance to inspect the clutch components.

⚠ CAUTION

Operating the vehicle with incorrect clutch pedal free-travel could result in clutch damage. See Group 25 of the *Business Class® M2 Workshop Manual* for free-pedal adjustment procedures and specifications.

On mechanical clutch linkages, free-pedal travel should be included and commented on daily in the driver's report, since clutch free-pedal travel is the best guide to the condition of the clutch and the release mechanism.

Clutch Wear

The major reason clutches wear out too soon is excessive heat. Clutches are designed to absorb and dissipate more heat than encountered in typical operation. The temperatures developed in typical operation will not break down the clutch friction surfaces. However, if a clutch is slipped excessively or required to do the job of a fluid coupling, high temperatures develop quickly and destroy the clutch. Temperatures generated between the flywheel, driven discs, and pressure plates can be high enough to cause the metal to flow and the friction facing material to char and burn.

⚠ CAUTION

Do not allow sustained slippage of the clutch; this could severely damage the clutch disc, pressure plate, or flywheel. Damage caused by clutch slippage due to improper break-in is not warrantable.

Slipping and excessive heat are practically nonexistent when a clutch is fully engaged. But during the moment of engagement, when the clutch is picking up the load, it generates considerable heat. An incorrectly adjusted or slipping clutch will rapidly generate sufficient heat to destroy itself.

The most important items that a driver should be aware of to ensure long service life of the clutch include: starting in the right gear, recognizing clutch malfunctions, and knowing when to adjust a clutch.

Clutch Adjustments

Some clutches have an internal adjustment. See the applicable section in **Group 25** of the *Business Class® M2 Workshop Manual* for clutch adjustment procedures and specifications.

⚠ CAUTION

Operating the vehicle with the clutch incorrectly adjusted could result in clutch or clutch brake failure.

Clutch Lubrication

The release bearing should be lubricated at frequent intervals. See **Group 25** of the *Business Class® M2 Maintenance Manual* for intervals and procedures.

⚠ CAUTION

Failure to lubricate the release bearing as recommended could result in release bearing damage and damage to the clutch.

NOTE: The Sachs hydraulic clutch does not require lubrication of the release bearing.

Sachs Hydraulic Clutch

The Sachs hydraulic clutch is a 14.5-inch (365 mm) push-type clutch that is used with the Mercedes-Benz medium-duty transmissions, models MBT520 and MBT660.

NOTE: All Mercedes-Benz transmission models require a hydraulic clutch system. For more information on the Mercedes-Benz transmissions, see under the heading "Mercedes-Benz Manual Transmissions."

The clutch hydraulic system consists of three main components:

- A pedal unit, including the pedal, master cylinder and fluid reservoir,
- A slave cylinder at the clutch,
- A hydraulic hose that connects the master and slave cylinders.

Keep the clutch fluid reservoir full to the MAX mark. If fluid level falls below the MIN mark, have the hydraulic system checked for leaks at an authorized Freightliner service facility. Use only DOT 4 brake fluid to fill the reservoir.

The hydraulic clutch provides smooth, quiet, and reliable clutch actuation with a minimum of maintenance.

Pressure builds up in the master cylinder when the clutch pedal is pressed. This pressure is transmitted through the brake fluid in the hose to the slave cylinder, where it acts directly on the clutch release fork.

Allison On-Highway Transmissions

The Allison on-highway transmissions are fully automatic and include the 1000 Series™, 2000 Series™, and 2400 Series™. Refer to the Allison website for additional information, **www.allisontransmission-.com**.

Safety Precautions

⚠ WARNING

Do not leave the vehicle unattended with the engine running. If you leave the vehicle and the engine is running, the vehicle can move suddenly, which could result in personal injury or property damage.

1000 Series

On vehicles with Allison 1000 series transmissions, do the following steps if you have to leave the cab with the engine running (for example, when checking the transmission fluid):

Without Park Position

1. Bring the vehicle to a complete stop using the service brake.
2. Ensure that the engine is at low idle rpm.
3. Put the transmission in neutral.
4. Apply the parking brake, and make sure it is properly engaged.
5. Chock the rear tires and take any other steps necessary to keep the vehicle from moving.

With Park Position

1. Bring the vehicle to a complete stop using the service brake.
2. Ensure that the engine is at low idle rpm.
3. Put the transmission in P (park).
4. Apply the parking brake (if equipped), and make sure it is properly engaged.
5. Engage the park range by slowly releasing the service brake.
6. Chock the rear tires and take any other steps necessary to keep the vehicle from moving.

2000 Series

On vehicles with Allison 2000 series transmissions, do the following steps if you have to leave the cab with the engine running (for example, when checking the transmission fluid):

Without Auto-Apply Parking Brake

Follow the instructions for vehicles with 1000 series transmissions, under the heading "Without Park Position."

With Auto-Apply Parking Brake

1. Bring the vehicle to a complete stop using the service brake.
2. Ensure that the engine is at low idle rpm.
3. Put the transmission in PB (auto-apply parking brake).
4. Apply the parking brake (if equipped), and make sure it is properly engaged.
5. Chock the rear tires and take any other steps necessary to keep the vehicle from moving.

2400 Series

On vehicles with 2400 series transmissions, follow the instructions for vehicles with 1000 series transmissions.

Range Inhibit Indicator, 2000 and 2400 Series

A RANGE INHIBIT indicator is a standard feature of the 2000 series and 2400 series transmissions. The RANGE INHIBIT indicator comes on to alert the driver that transmission operation is being inhibited and that the range shifts being requested by the driver may not occur. When certain operating conditions are detected by the TCM (transmission control module), the controls will lock the transmission in the current operating range.

Shift inhibits occur under the following conditions:

- Shifts from neutral to reverse or from neutral to a forward range when the engine is above idle, greater than 900 rpm.

- Forward/reverse directional shifts are typically not permitted if appreciable output shaft speed is detected.
- When some types of unusual transmission operating conditions are detected by the TCM, the TCM temporarily limits transmission operation until the vehicle can be driven to a service location. When this type of situation is detected, the TCM will lock the transmission in a safe gear range.
- The TCM will prevent shifts from park or neutral to range when auxiliary equipment, such as a power takeoff unit (PTO), is in operation.

Operating Instructions, On-Highway Transmissions

Allison automatic transmissions are electronically controlled. The shift selector provides five or six forward ranges and one reverse range.

P (Park, optional on 1000 and 2400 Series)

Use park when turning the engine on or off, to check vehicle accessories, to operate the engine in idle for longer than 5 minutes, and for stationary operation of the power takeoff, if equipped. This position places the transmission in neutral and engages the park pawl of the transmission.

NOTE: This does not apply the parking brake.

PB (Auto-Apply Parking Brake, optional on 2000 Series)

The auto-apply parking brake places the transmission in neutral and applies the parking brake.

R (Reverse)

Reverse is used to back the vehicle. When the selector is in reverse, the reverse warning signal will sound. Always bring the vehicle to a complete stop before shifting from a forward range to reverse, or from reverse to a forward range.

⚠ CAUTION

Extended idling in reverse may cause transmission overheating and damage.

Do not idle in reverse for more than 5 minutes. Select P (park), PB (auto-apply parking brake), or N (neutral) when time at idle exceeds 5 minutes.

NOTE: The shift into reverse may not succeed if a range inhibitor is active. Check for illumination of the RANGE INHIBIT indicator.

N (Neutral)

The neutral position places the transmission in neutral. This position is used when starting the engine and for stationary operation.

⚠ WARNING

Failure to apply the vehicle parking brakes when the transmission is in neutral may allow the vehicle to move unexpectedly, possibly causing property damage or personal injury.

When neutral is selected, the vehicle service brakes, parking brake, or emergency brake must be applied. Selecting neutral does not apply vehicle brakes unless an auxiliary system to apply the parking brake is installed.

⚠ WARNING

Do not coast in neutral. Coasting in neutral can cause an accident, possibly resulting in severe personal injury or death.

Do not let the vehicle coast in neutral. If the vehicle is allowed to coast in neutral, the engine brake will not work and you could lose control of the vehicle.

⚠ CAUTION

Coasting in neutral can cause severe transmission damage.

D (Drive)

⚠ WARNING

When going downhill, use a combination of downshifting, braking, and other retarding devices to control vehicle speed and the engine's rated governed speed. Failure to do so could reduce vehicle braking, possibly causing loss of vehicle control and resulting in personal injury or property damage.

In the drive position, the transmission will initially go into first range when drive is selected. As vehicle speed increases, the transmission will upshift automatically through each available range up to fourth range or fifth range. As the vehicle slows, the transmission will downshift automatically.

When going downhill, downshift to a lower transmission range to increase engine braking and to help maintain control. The transmission has a feature to prevent automatic upshifting above the lower range selected. However, during downhill operation, the transmission may upshift to the next higher range, if the engine is exceeding its governed speed in the lower range.

⚠ CAUTION

Do not idle in drive for more than 5 minutes. Extended idling in drive may cause transmission overheating and damage. Always select PB (auto-apply parking brake) or P (park) if time at idle is longer than 5 minutes.

NOTE: The shift into drive may not succeed if a range inhibitor is active. Check for illumination of the RANGE INHIBIT indicator.

4 and 3 (Fourth and Third Ranges, optional)

Use the fourth or third range for city traffic and for braking on steep downgrades.

3 and 2 (Third and Second Ranges, standard)

Use the third or second range for heavy city traffic and for braking on steeper downgrades.

1 (First Range)

Use first range when pulling through mud or deep snow, when maneuvering in tight spaces, or when driving up or down very steep grades. First range provides the vehicle with its maximum driving torque and maximum engine braking effect.

NOTE: To have the transmission select these ranges automatically, leave the selector lever in D (drive).

Allison MD Series

Refer to the Allison website for additional information, **www.allisontransmission.com**.

Safety Precautions

⚠ WARNING

Do not leave the vehicle unattended with the engine running. If you leave the vehicle and the engine is running, the vehicle can move suddenly, which could result in personal injury or property damage.

On vehicles with MD series transmissions, do the following steps if you have to leave the cab with the engine running (for example, when checking the transmission fluid):

1. Bring the vehicle to a complete stop using the service brake.
2. Put the transmission in N (neutral).
3. Ensure that the engine is at low idle (500 to 800 rpm).
4. Apply the parking brake and emergency brakes, and make sure they are properly engaged.
5. Chock the rear tires and take any other steps necessary to keep the vehicle from moving.

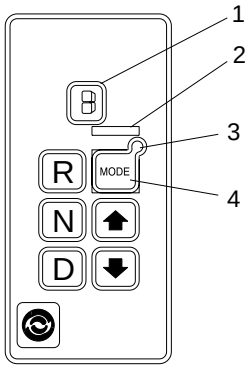
Operating Instructions, MD Series

The Allison MD transmission is electronically controlled and comes with a push-button shift control that provides five or six forward ranges and one reverse range. The push-button shift selector has an R (reverse), an N (neutral), a D (drive), an up arrow, a down arrow, a mode button, and a digital display.

New shift controls — known as "fourth generation" — were introduced in mid-2006. They replaced the previous units that are commonly referred to as "WTEC III". See **Fig. 8.1** and **Fig. 8.2**.

R (Reverse)

Press the R button to select reverse. The digital display will show R when reverse is selected. Always bring the vehicle to a complete stop and let the engine return to idle before shifting from a forward range to reverse, or from reverse to a forward range.



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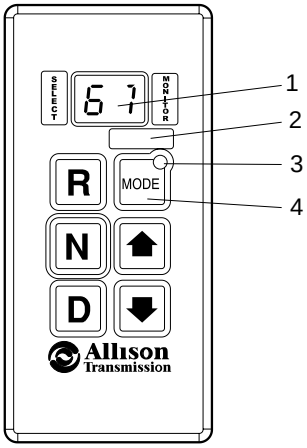
1. Digital Display
2. Mode Identification Label
3. Mode Indicator LED
4. Mode Button

Fig. 8.1, WTEC III Push-Button Shift Selector



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1. Digital Display
2. Mode Identification Label
3. Mode Indicator LED
4. Mode Button

Fig. 8.2, Fourth Generation Push-Button Shift Selector

⚠ CAUTION

Extended idling in reverse may cause transmission overheating and damage.

Do not idle in reverse for more than 5 minutes. Select neutral when time at idle exceeds 5 minutes.

NOTE: The shift into reverse may not succeed if a range inhibitor is active. When reverse is selected, always be sure that R is not flashing.

N (Neutral)

⚠ WARNING

When starting the engine, make sure that the service brakes are applied. Failure to apply the service brakes may result in unexpected vehicle movement, which could cause severe personal injury or death. Failure to apply the vehicle parking brakes when the transmission is in neutral may allow the vehicle to move unexpectedly, possibly causing property damage or personal injury.

Press the N button to select neutral. The digital display will display N when neutral is selected. It is not necessary to press neutral before starting the vehicle. The ECU (electronic control unit) or TCM (transmission control module) automatically places the transmission in neutral at start-up.

⚠ WARNING

Failure to apply the vehicle parking brakes when the transmission is in neutral may allow the vehicle to move unexpectedly, possibly causing property damage or personal injury.

When neutral is selected, the vehicle service brakes, parking brake, or emergency brake must be applied. Selecting neutral does not apply vehicle brakes unless an auxiliary system to apply the parking brake is installed.

⚠ WARNING

Do not coast in neutral. Coasting in neutral can cause an accident, possibly resulting in severe personal injury or death.

Do not let the vehicle coast in neutral. If the vehicle is allowed to coast in neutral, the engine brake will not work and you could lose control of the vehicle.

Always select neutral before turning off the engine. Neutral is also used during stationary operation of the power takeoff if your vehicle is equipped with a PTO.

D (Drive)

When the D button is pushed, the highest forward range will appear in the display. The transmission will normally go into first range when drive is selected (except for those units programmed to start in second range). As vehicle speed increases, the transmission will upshift automatically through each range. As the vehicle slows, the transmission will downshift automatically.

⚠ CAUTION

Do not idle in drive for more than 5 minutes. Extended idling in drive may cause transmission overheating and damage. Always select neutral if time at idle is longer than 5 minutes.

NOTE: The shift into drive may not succeed if a range inhibitor is active. When drive is selected, always be sure that D is not flashing.

5, 4, 3, and 2 (Fifth, Fourth, Third, and Second Ranges)

Occasionally, road conditions, load, or traffic conditions will make it desirable to restrict automatic shifting to a lower range. Lower ranges provide greater braking for going down grades. The lower the range, the greater the braking effect.

Push the up or down arrows on the push-button shift selector to select individual forward ranges. The digital display will display your choice of range. When a lower range is selected, the transmission may not downshift until the vehicle speed or engine RPM (engine governed speed) is reduced.

⚠ WARNING

When going downhill, use a combination of downshifting, braking, and other retarding devices to control vehicle speed and the engine's rated governed speed. Failure to do so could reduce vehicle braking, possibly causing loss of vehicle control and resulting in personal injury or property damage.

When going downhill, downshift to a lower transmission range to increase engine braking and to help maintain control. The transmission has a feature to prevent automatic upshifting above the lower range selected. However, during downhill operation, if the engine governed speed is exceeded in the lower range, the transmission may upshift to the next higher range.

1 (First Range)

Use the first range when pulling through mud or deep snow, when maneuvering in tight spaces, or when driving up or down steep grades. First range provides the vehicle with its maximum driving torque and maximum engine braking effect. Push the down arrow until the first range appears on the display.

Up and Down Arrows

When a lower range is desired, after D has been pressed, press the down arrow until the desired range is shown on the display. Pressing the down arrow continuously causes the range position to continue to go down until the button is released or the lowest range is attained.

When the transmission is in drive and the down arrow has the transmission in a lower range position, press the up arrow to shift to a higher selector position. Pressing the up arrow continuously causes the range position to continue to rise until the button is released or the highest available position is attained.

Pressing the up or down arrows does not override the transmission automatic shifting operation. If a higher or lower position is selected, the transmission continues shifting through the ranges according to the vehicle operating characteristics until the highest or lowest selected position is reached.

Mode Button

The MODE button starts a specialized input or output function that has been previously programmed into the ECU or TCM. Pressing the MODE button changes transmission operation for a specific function.

Mode Indicator LED

When the MODE button is pressed, the mode indicator LED illuminates. A mode identification label, located above the MODE button, identifies the function associated with a mode change.

Digital Display

The dual digital display shows both the selected range (SELECT) and actual range attained (MONITOR). The single digital display shows the selected range.

Oil Level Sensor

Allison MD Series transmissions have an electronic oil level sensor to read fluid level information. The fluid level diagnostic will display whether the oil level is OK, too low, or too high. It will also display a default code and indicate if the preconditions (of receiving the fluid level information) are not met.

IMPORTANT: Maintain the the proper fluid level at all times. If the fluid level is too low, the converter and clutch do not receive an adequate supply of fluid. If the level is too high, the transmission may shift erratically or overheat.

To access the oil level display mode, park the vehicle on a level surface, shift to N (Neutral), apply the parking brake, and idle the engine. Then simultaneously press both the up and down arrows once. The oil level will display at the end of a two-minute countdown.

Diagnostic Codes

Diagnostic codes are numerical indications relating to a malfunction in transmission operation. These codes are logged in the TCM/ECU memory. The most severe or most recent code is listed first. A maximum of five codes (numbered d1-d5) may be listed in memory at one time. If the mode indicator LED is illuminated, the displayed code is active. If it is not illuminated, the displayed code is not active.

NOTE: During normal operation, an illuminated mode indicator LED signifies the specialized mode operation is in use.

To enter diagnostics mode, first park the vehicle and apply the parking brake. Then simultaneously press both the up and down arrows twice.

Eaton® Fuller® Straight-Shift Transmissions

Refer to the Eaton website for additional information, **www.roadranger.com**.

General Information, Straight-Shift

Eaton Fuller 5-speed FS models are fully synchronized. They have five forward speeds and one reverse. See **Fig. 8.3** for the shift pattern.

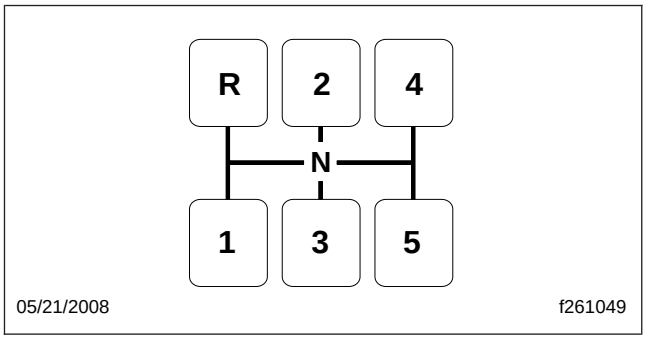


Fig. 8.3, Shift Pattern, 5-Speed FS Models

Eaton Fuller 6-speed FS and FSO models are fully synchronized. They have six forward speeds and one reverse. See **Fig. 8.4** for the shift pattern.

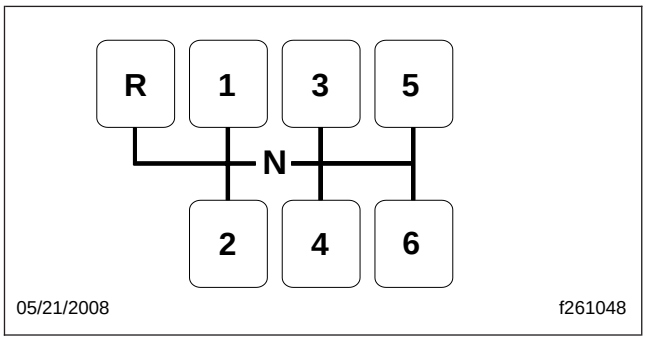


Fig. 8.4, Shift Pattern, 6-Speed FS and FSO Models

Eaton Fuller 7-speed T models are not synchronized. They have seven forward speeds and one reverse. See **Fig. 8.5** for the shift pattern.

These transmissions are designed for use with on-highway, fuel economy engines where a minimum of shifting is desired and less gear reduction is acceptable.

Operation, Straight-Shift

1. Always use first gear when starting to move the vehicle forward.

IMPORTANT: Do not rest your foot on the clutch pedal while driving. This causes partial clutch

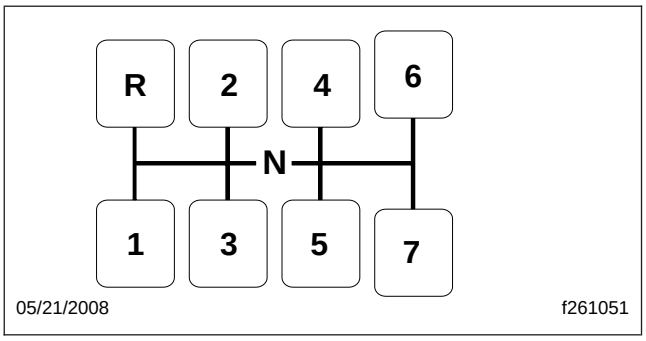


Fig. 8.5, Shift Pattern, 7-Speed T Models

disengagement which could cause premature clutch wear.

2. On synchronized models, press the clutch pedal to the floor when shifting gears. Double-clutching is unnecessary.

   On unsynchronized models, press the clutch pedal to the floor to contact the clutch brake only when engaging the first or reverse gears.

NOTE: If the vehicle is moving when shifting, press the clutch pedal just far enough to disengage the clutch. Pressing it to the floor will engage the clutch brake, if so equipped, causing premature clutch brake wear.

3. To upshift, do the following steps:

   3.1 Accelerate to engine governed speed.

   3.2 On synchronized models, disengage the clutch and move the shift lever to second gear.

   On unsynchronized models, disengage the clutch and move the shift lever to neutral. Engage the clutch again. With the shift lever in neutral, disengage the clutch and move the shift lever to second gear.

   3.3 Engage the clutch and note the drop in engine rpm before accelerating up to engine governed speed again.

   3.4 Continue upshifting using the same sequence described in the previous step. Follow the pattern on the shift lever.

4. To downshift, do the following steps:

   4.1 Wait until the engine speed drops to the rpm noted immediately after the upshift.

   4.2 On synchronized models, disengage the clutch and move the shift lever to the next lower gear.

   On unsynchronized models, disengage the clutch and move the shift lever to neutral. Engage the clutch again. With the shift lever in neutral, disengage the clutch and move the shift lever to the next lowest gear.

   4.3 Engage the clutch smoothly.

   4.4 Use the sequence described above to shift progressively down through each successive lower gear, as driving conditions require.

Eaton Fuller Range-Shift Transmissions

Refer to the Eaton website for additional information, **www.roadranger.com**.

General Information, Range-Shift

Eaton Fuller 9-Speed Models

Eaton Fuller 9-speed range-shift models are not synchronized. They have nine forward speeds and two reverse speeds. The shift lever controls five forward gears and one reverse gear in the transmission front section, and the range lever controls a LO and HI range in the two-speed auxiliary section. The first position in the front section is used only as a starting gear. The other four ratios are used once in LO range and once again in HI range. See **Fig. 8.6** for the shift patterns.

After shifting out of the first gear position, use the Roadranger® "repeat H" shift pattern. Select both LO range and HI range with the range lever (range knob). It is used once during the upshift sequence and once during the downshift sequence.

Always preselect the range shift. After preselection, the transmission will automatically make the synchronizer range shift as the shift lever passes through neutral.

Eaton Fuller 10-Speed Models

Eaton Fuller 10-speed range-shift models are not synchronized. They have ten forward speeds and

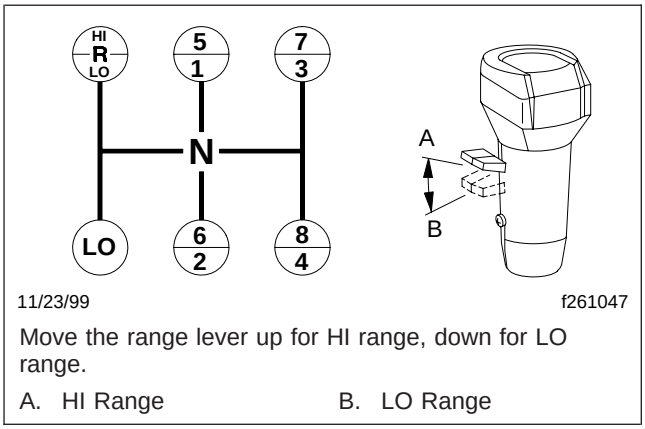


Fig. 8.6, Shift Pattern, 9-Speed Models

two reverse speeds. The shift lever controls five forward gears and one reverse gear in the transmission front section, and the range lever controls a LO and HI range in the two-speed auxiliary section. The five forward gears selected in LO range are used again in HI range to provide the 10 progressive forward gears. See **Fig. 8.7** for the shift patterns. See **Table 8.1** for the shift progressions.

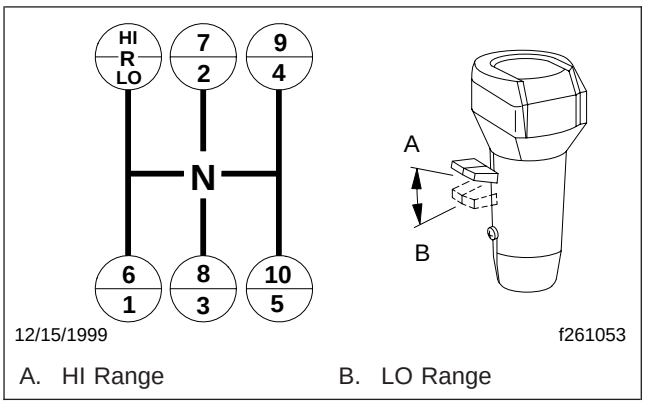


Fig. 8.7, Shift Pattern, 10-Speed Models

Once the highest shift lever position (fifth gear) is reached in LO range, the driver preselects the range shift lever for HI range. The range shift occurs automatically as the shift lever is moved from fifth gear position to the sixth gear position.

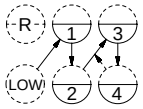
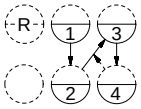
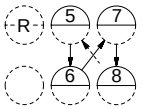
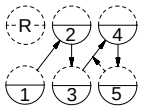
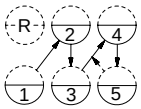
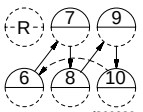
Eaton Fuller Shift Progressions			
Model	LO Range		HI Range
	Off-Highway	On-Highway	
9-Speed Direct or Overdrive	 f260322	 f260323	 f260324
10-Speed Direct or Overdrive	 f260329	 f260329	 f260330

Table 8.1, Eaton Fuller Shift Progressions

When downshifting, the driver preselects the range lever for LO range and the range shift occurs automatically during the shift lever movement to the next gear position.

Eaton Fuller Deep-Reduction Models

Eaton Fuller deep-reduction models are not synchronized. They have a five-speed front section and a two-speed auxiliary section which has an extra deep reduction gear. The LO gear in the front section is used only as a starting gear. The other four ratios are used once in LOW RANGE and once in HIGH RANGE giving eight highway ratios. LO-LO is selected by the DEEP REDUCTION lever on the dashboard. See **Fig. 8.8** for the shift pattern.

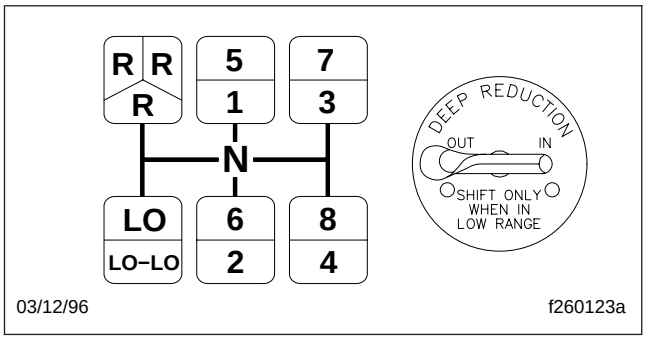


Fig. 8.8, Shift Pattern, Deep Reduction

Operation, Range-Shift

1. When operating off-highway or under adverse conditions, always use low gear when starting to move the vehicle.

When operating on-highway, with no load or under ideal conditions, use first gear when starting to move the vehicle.

For all conditions, use the highest gear that is still low enough to start the vehicle moving with the engine idling and without excessively slipping the clutch.

2. Use the clutch brake to stop gear rotation when shifting into low (or first) or reverse when the vehicle is stationary. The clutch brake is applied by pressing the clutch pedal all the way to the floor.

   For normal upshifts and downshifts, only a partial disengagement of the clutch is necessary to break engine torque.

3. Do not make range shifts with the vehicle moving in reverse gear.
4. Never attempt to move the range preselection lever with the gear shift lever in neutral while the vehicle is moving. Preselection with the range preselection lever must be made prior to moving the shift lever out of gear into neutral.
5. Do not shift from high range to low range at high vehicle speeds.
6. Use double-clutching between all upshifts and downshifts.
7. After your shifting ability improves, you may want to skip some of the ratios. This may be done only when operating conditions such as load, grade, and road speed permit.

Upshifting

1. Position the gear shift lever in neutral. Start the engine and bring the air system pressure up to 100 to 120 psi (689 to 827 kPa).
2. Position the range preselection lever down into low range.
3. Press the clutch pedal to the floor. Shift into low or first gear, then engage the clutch with the engine at or near idle speed to start the vehicle moving. Accelerate to 80 percent of engine governed speed.
4. Shift progressively up from low or 1st gear to the top gear in low range, double-clutching between shifts and accelerating to 80 percent of engine governed speed.
5. While in the top gear of the low-range shift pattern and ready for the next upshift, flip the range preselection lever up into high range. Double-clutch through neutral and shift into the bottom gear in high range. As the shift lever passes through neutral, the transmission will automatically shift from low range to high range.
6. With the transmission in high range, shift progressively up through each of the high range gears, double-clutching between shifts.

Downshifting

1. With the transmission in high range, shift progressively down to the bottom gear in high range, double-clutching between shifts.
2. When in the bottom gear of the high-range shift pattern and ready for the next downshift, push the range preselection lever down into low range. Double-clutch through neutral and shift into the top gear of the low-range shift pattern. As the shift lever passes through neutral, the transmission will automatically shift from high range to low range.
3. With the transmission in low range, downshift through the low range gears as conditions require.

   Never use the clutch brake when downshifting or as a brake to slow the vehicle.

Operation, Deep-Reduction Models

Upshifting

1. Position the gear shift lever in neutral. See **Fig. 8.8** for the shift pattern. Start the engine, and bring the air system pressure up to 95 to 125 psi (655 to 862 kPa).
2. Position the range preselection lever down, into low range.

NOTE: If conditions are difficult, start out in LO-LO. Move the DEEP REDUCTION lever on the dashboard to the IN position. Otherwise start out in LO with the DEEP REDUCTION lever in the OUT position.

3. Depress the clutch pedal to the floor. Shift into LO gear; then, engage the clutch, with the engine at or near idle rpm to start the vehicle moving. The vehicle will start in LO or LO-LO depending on the DEEP REDUCTION lever position.
4. To upshift if in LO-LO, move the DEEP REDUCTION lever to the OUT position and *immediately* release the accelerator, depress the clutch pedal once to break torque, and reengage the clutch. The auxiliary section will shift from LO-LO to LO when the gears reach the same speed.
5. Shift progressively upward from LO through 1st, 2nd, 3rd, and 4th gears while the range preselection lever is in LO. Always double-clutch between gears.
6. When in 4th gear and ready for the next upshift, pull up the range preselection lever and move the shift lever, double-clutching, to the 5th gear position. As the shift lever passes through neutral, the auxiliary section will automatically shift from low to high range.

CAUTION

Never move the shift lever into the LO gear position after high range preselection or anytime the auxiliary section is in high range. Transmission damage could result.

7. Continue upshifting from 5th gear through 8th gear, always double-clutching between gears.

Downshifting

1. While in high range, move the gear shift lever from 8th gear through 5th gear as conditions require, always double-clutching between gears.
2. When in 5th gear and ready for the next downshift, push down the range preselection lever and move the shift lever to the 4th gear position, being sure to double-clutch. As the shift lever passes through neutral, the auxiliary section will automatically shift from high to low range.
3. While in the low range, continue downshifting from 4th through LO as conditions require, always double-clutching between gears.
4. *Do not* downshift into LO-LO from LO unless operating conditions make it necessary. If it is necessary, make sure that the shift lever is in the LO gear position and the auxiliary section is in the low range. Then, move the DEEP REDUCTION lever on the dashboard to the IN position. *Immediately* release the accelerator, depress the clutch pedal once to break torque, engage the clutch, and accelerate. The auxiliary section will automatically shift from LO to LO-LO when the gears reach the same speed.

CAUTION

Never use the clutch brake when downshifting, or as a brake to slow the vehicle. This will cause premature clutch brake wear.

Eaton Fuller AutoShift™

Refer to the Eaton website for additional information, **www.roadranger.com**.

IMPORTANT: Before starting the vehicle, always do the following:

- Be seated in the driver's seat.
- Place the transmission in neutral.
- Set the parking brakes.
- Press the clutch pedal (if equipped) down to the floor.

The AutoShift ASW is an automated 6-speed Eaton Fuller transmission. No clutch is necessary to operate the vehicle.

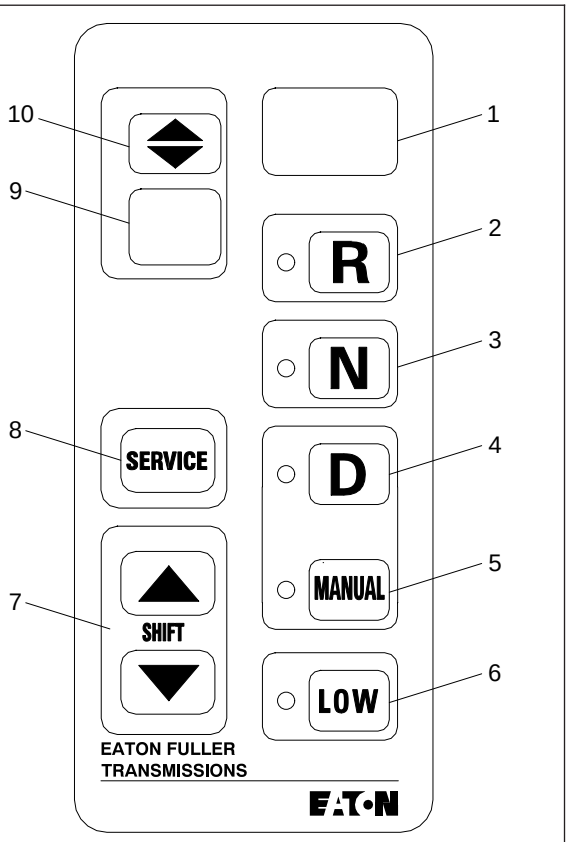
The AutoShift AS2 is a partially automated 10-speed Eaton Fuller transmission. The driver must use the clutch and put the transmission in neutral to start and stop the vehicle. A push-button shift selector (**Fig. 8.9**) is used with AutoShift AS2 and ASW transmissions.

IMPORTANT: If you have to leave the cab with the engine running:

- Place the transmission in neutral.
- Set the parking brakes.
- Chock the tires.

Push-Button Shift Selector

Gear information is presented to the driver on the push-button shift selector, usually mounted on the



1. Not Used
2. R (reverse)
3. N (neutral)
4. D (drive)
5. MANUAL Mode
6. Low Gear Hold
7. Upshift/Downshift Arrows
8. SERVICE Light
9. Mode Indicator
10. Mode Button

Fig. 8.9, Eaton Push-Button Shift Selector

right-hand control panel. On this display, the information is presented as follows:

- To select neutral, press the N button. When neutral is engaged, the telltale LED will light up next to the N button.
- To select reverse, press the R button. When reverse is engaged, the telltale LED will light up next to the R button.
- To select drive, press the D button. When drive is engaged, the telltale LED will light up next to the D button.
- To select low gear, press the LOW button. When low is engaged, the telltale LED will light up next to the LOW button.
- To change gears manually, press the MANUAL button. When the manual mode is engaged, the telltale LED will light up next to the MANUAL button.
- Use the shift buttons (upshift/downshift) to change the current starting gear selection in R, D, and LOW. In MANUAL, the shift buttons can be used to select gears.
- In automatic mode, the number of the forward gear currently engaged appears continually on the mode indicator when in drive. In MANUAL, the last gear selected appears on the mode indicator.
- If the SERVICE indicator illuminates, take the vehicle as soon as possible to an authorized Freightliner service facility.
- The mode button is reserved for future use.

IMPORTANT: To prevent engine overspeed, the transmission software will override both MANUAL and LOW if necessary. The system will not respond to gear selection requests that will either overspeed or excessively lug the engine.

Automatic Mode

The AutoShift AS2 transmission is normally operated in an automatic mode. To select MANUAL mode, press the MANUAL button on the push-button shift selector.

When the transmission is in automatic mode, the transmission automatically selects and engages the gears, although the transmission will respond to upshift and downshift requests as though in manual mode. See the instructions for shifting under heading "Manual Mode" below.

Manual Mode

When the transmission is in manual mode, the driver must select the appropriate gear, using the shift buttons on the push-button shift selector.

To upshift in MANUAL, press the upshift button (up arrow), and release. The number of the gear will appear on the mode indicator. If the requested gear is available, the transmission will shift up.

CAUTION

Do not attempt to upshift until the vehicle has reached a sufficient speed. The clutch absorbs the speed difference by generating heat, which causes the clutch to wear out too soon.

Many drivers upshift into the next gear or even skip-shift into a higher gear before the vehicle has reached the correct speed. This type of shifting is almost as bad as starting off in a gear that is too high. When the engine speed (rpm) and the vehicle speed (mph or km/h) are too far apart, the clutch must absorb the difference in speed by generating heat.

To downshift in MANUAL, press the downshift button (down arrow), and release. The number of the gear will appear on the mode indicator. If the requested gear is available, the transmission will shift down.

If any requested gear is not available, an audible warning will sound and the digital display will indicate that the gear is not available.

Selecting Gears

R (Reverse)

Reverse (R) is used to back the vehicle. Make sure the vehicle comes to a full stop and the clutch pedal has been pressed before shifting into reverse.

To select reverse, press the clutch pedal to the floor. Then press the R button.

N (Neutral)

Neutral (N) is used for starting, parking, or any stationary operation. No gear is selected. The transmission must be in neutral to start the engine.

IMPORTANT: If the vehicle starts up in any gear but neutral, bring the vehicle to an authorized Freightliner service facility as soon as possible.

To select neutral, press the clutch pedal to the floor. Then press the N button. Set the parking brakes and slowly release the clutch pedal.

NOTE: Neutral is always available during vehicle operation. When in neutral, requests to upshift or to downshift are ignored.

D (Drive)

Drive (D) is used for normal highway driving. In drive, the transmission shifts into the proper gear for starting, and then automatically selects additional gears as needed, in a range between the starting gear and the highest gear.

To select drive, press the clutch pedal to the floor. Then press the D button. Slowly release the clutch pedal and drive the vehicle.

To start up in a gear other than the normal starting gear, push the upshift arrow with D selected, and while the vehicle is stopped.

IMPORTANT: AutoShift will not start up in any gear higher than third gear.

The number of the gear selected will flash on the auxiliary display until the driver presses the clutch pedal. This gear will be stored in memory as the default starting gear until a different starting gear is selected by the driver, or until the engine is shut down.

NOTE: The transmission may be programmed so that it is not possible to select a starting gear other than the preprogrammed starting gear.

L (Low)

LOW is used to hold the transmission in low gear when descending steep hills. If LOW is selected when the vehicle is stopped, the transmission remains in low gear until drive is selected. If LOW is selected while the vehicle is moving, the transmission downshifts at a higher engine speed than normal, in order to maximize the engine braking effect.

To select LOW, press the clutch pedal to the floor. Then press the LOW button. Slowly release the clutch pedal and drive the vehicle.

IMPORTANT: Before parking the vehicle, always do the following:

- Place the transmission in neutral.
- Set the parking brakes.
- Chock the tires, if parking on an incline.

Freightliner SmartShift Shift Control

General Information, SmartShift

The SmartShift transmission control is an electronic transmission control device. It is installed with the following transmissions:

- Eaton Fuller UltraShift™
- Mercedes-Benz Automated Gear Shift (AGS)

It replaces the typical floor-mounted shift lever or dash-mounted push button control.

SmartShift accepts driver requests for transmission functions and transmits them through hard wiring to the transmission control unit (TCU). SmartShift is a true shift-by-wire system.

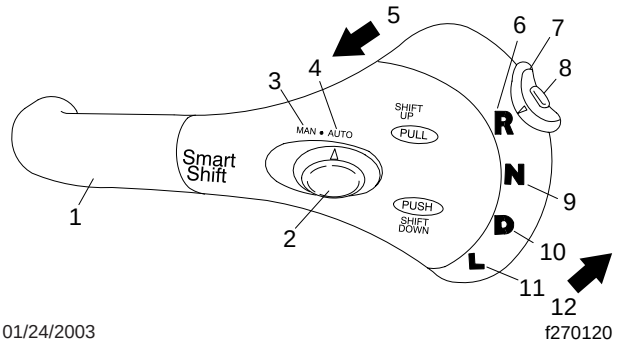
SmartShift offers two main advantages over conventional transmission control devices. Without a floor-mounted shift control, usable cab space is increased. The SmartShift control mounts to the right-hand side of the steering column and is operated by the fingers of the driver's right hand, allowing both hands to remain on the steering wheel.

A two-position slide switch (**Fig. 8.10**) is mounted on the body of the control lever just before the paddle widens out. The slide switch allows the driver to choose automatic (AUTO) or manual (MAN) mode.

In AUTO mode, gears shift automatically, without driver interaction. Manual gearshifts are accomplished by a momentary pull or push on the control in the plane perpendicular to the steering wheel. Pull upward (toward you) on the control to upshift and push downward (away from you) to downshift. The control is spring-loaded and returns to mid-position when released after an upshift or downshift.

For Eaton Fuller UltraShift (**Fig. 8.10**), a four-position (R, N, D, L) selector switch is located at the end of the lever. For the Mercedes-Benz AGS (**Fig. 8.11**), a three-position (R, N, D) selector switch is located at the end of the lever.

Embedded in the selector switch is a small neutral lock button to prevent accidental shifts into gear from neutral. Any time you shift through N, press down on the neutral lock button to move the switch from neutral (N) to another gear, such as drive (D), low (L), or reverse (R). When shifting to N, it is not necessary to press the neutral lock button.



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To upshift manually, pull the lever up (towards you). To downshift manually, push the lever down (away from you).

1. SmartShift Control Lever
2. Slide Switch (forward driving mode switch)
3. MAN Mode (of slide switch)
4. AUTO Mode (of slide switch)
5. Upshift Direction
6. Reverse Position (of selector switch)
7. Selector Switch
8. Neutral Lock Button
9. Neutral Position (of selector switch)
10. Drive Position (of selector switch)
11. Low Position (of selector switch)
12. Downshift Direction

Fig. 8.10, SmartShift Control (with Eaton Fuller UltraShift)

Eaton Fuller UltraShift

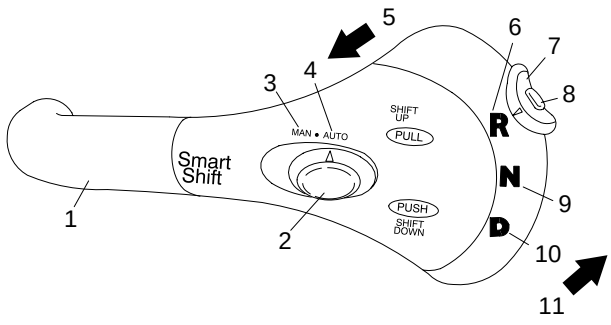
The Eaton® Fuller® UltraShift™ transmission uses the four-position SmartShift control lever on the steering column to change gears, combined with a gear indicator on the right-hand control panel as shown in **Fig. 8.12**. All forward shifts can be made either manually or automatically, at the driver's choice. No clutch pedal is required to operate the vehicle.

General Information, UltraShift ASW

UltraShift ASW is a six-speed medium-duty fully automated transmission used on the M106 only. Six-speed UltraShift ASW uses a "wet" clutch system in which the drive and driven discs rotate in a bath of transmission fluid (Dexron III).

General Information, UltraShift DM

UltraShift DM is a ten-speed heavy-duty fully-automated transmission used on the M112 only. Ten-speed UltraShift DM uses a dry clutch system which



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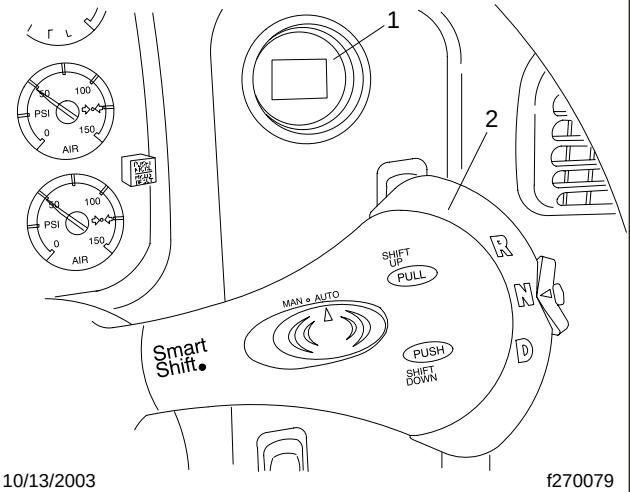
To upshift manually, pull the lever up (towards you). To downshift manually, push the lever down (away from you).

1. SmartShift Control Lever
2. Slide Switch
3. MAN Position (of slide switch)
4. AUTO Position (of slide switch)
5. Upshift Direction
6. Reverse Position (of selector switch)
7. Selector Switch
8. Neutral Lock Button
9. Neutral Position (of selector switch)
10. Drive Position (of selector switch)
11. Downshift Direction

Fig. 8.11, SmartShift Control (with Mercedes-Benz AGS)



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To know what gear the transmission is in, look at the current gear indicator.

1. Gear Indicator
2. SmartShift Control

Fig. 8.12, Shift Controls and Indicators, UltraShift Transmissions

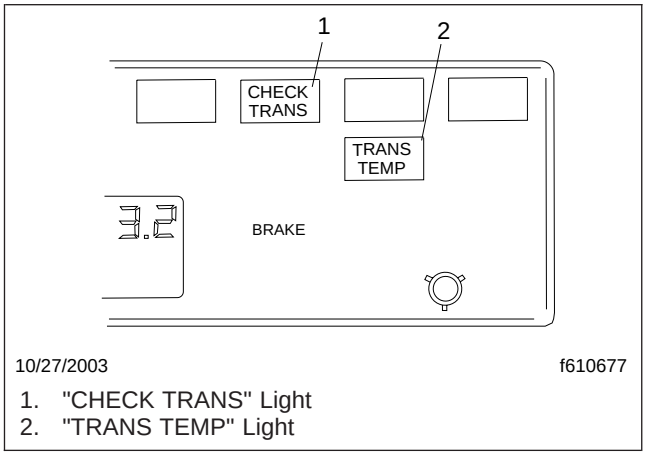
is offered only on this automated transmission system.

Operation, UltraShift

Power Up

NOTE: These operating instructions apply equally to six-speed UltraShift ASW and ten-speed UltraShift DM, with the exceptions explained below.

1. With the parking brake set, select neutral (N) by moving the selector switch to the N position.
2. With the transmission in neutral, turn on the ignition switch. The "CHECK TRANS" and "TRANS TEMP" telltale lights come on and go out again (bulb check). See **Fig. 8.13**.



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1. "CHECK TRANS" Light
2. "TRANS TEMP" Light

Fig. 8.13, Telltale Lights, UltraShift Transmission

3. After the ignition is turned on, the current gear indicator shows the dot display, arranged in a square pattern. All dots in the pattern should light up, without gaps or spaces. See **Fig. 8.14**.
4. Wait for the current gear indicator to show a solid "N." When the "N" is solid, rather than flashing, the UltraShift transmission control unit (TCU) is powered up. Apply the service brake and start the engine.
5. Select drive (D) by pressing in the neutral lock button and moving the selector switch downward to the position below neutral. Release the parking brake. The gear is displayed on the current gear indicator.

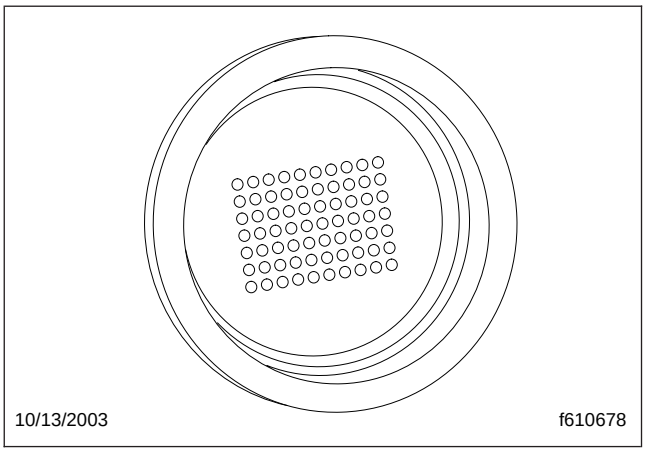


Fig. 8.14, Power-Up Dot Display

NOTE: When D is selected, the transmission controller starts up in second gear. On both six-speed Ultrashift ASW and ten-speed Ultrashift DM, the driver can select to start up in first. No other start gear is available.

6. On a level grade, release the service brake and press down on the throttle pedal to allow the vehicle to move forward.

⚠ WARNING

When starting or stopping on hills and grades, use extra care to prevent the vehicle from rolling back. A rollback accident could cause death, serious personal injury, or property damage.

7. Prevent the vehicle from rolling backward when stopped on a hill or grade, or when the vehicle is starting from a stop on a hill or grade.

   7.1 *To start from a full stop on a hill or grade*, quickly move your foot from the brake pedal and press firmly on the throttle pedal.

   On steep hills, set the parking brake and release it only when there is enough engine power to prevent rollback.

   7.2 *To stop on a hill or grade*, press and hold the brake pedal to keep the vehicle from moving.

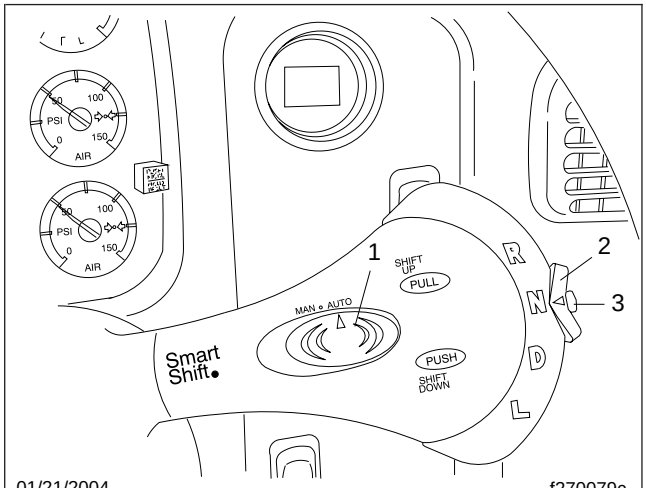
   On steep hills, set the parking brake. When parking, chock the tires, front and/or rear. Never hold a hill with the throttle pedal. This will cause the clutch to overheat.

Power Down

1. Apply the service brake.
2. Select neutral (N) by moving the selector switch to the N position. When the "N" on the gear indicator is solid, rather than flashing, the UltraShift TCU is ready to power down. See **Fig. 8.13**.
3. With the transmission in neutral, set the parking brake.
4. Turn off the ignition key and shut down the engine.

Automatic and Manual Modes

The SmartShift control has a slide switch located on the body of the control lever just before the paddle widens out. See **Fig. 8.15**. The slide switch controls the forward driving mode, automatic or manual.



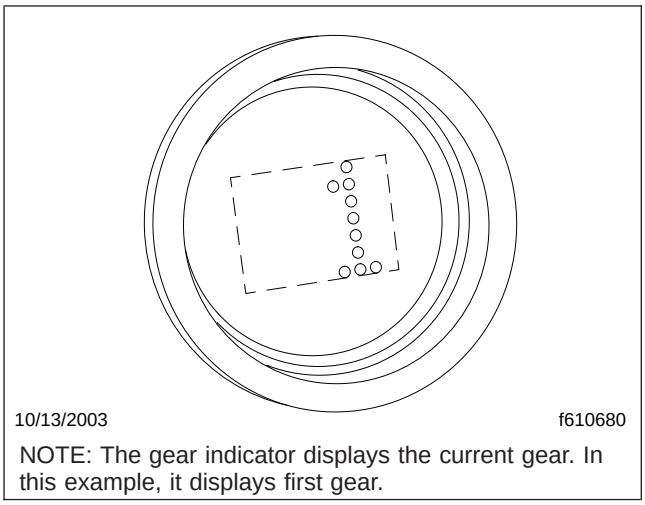
1. Slide Switch (controls forward driving mode)
2. Selector Switch (controls gear selection)
3. Neutral Lock Button (prevents accidental shift into gear)

Fig. 8.15, Switches, Ultrashift Transmission

To change mode at any time, move the slide switch in the desired direction. This allows the driver to respond to a wide range of driving conditions, such as blind corners, tight curves, and steep hills.

IMPORTANT: Whatever the mode, it is always possible to shift manually by moving the lever up or down as needed. When the engine speed is within 75 revolutions per minute (rpm) of the load-based shift point for an automatic shift, the UltraShift TCU will advance the shift.

In either mode, the gear indicator displays the current gear. See **Fig. 8.16**.



NOTE: The gear indicator displays the current gear. In this example, it displays first gear.

Fig. 8.16, Current Gear Display

At the start of a shift, the current gear continues to display until the transmission has been pulled into neutral. At this point, as the transmission is synchronizing for the new (target) gear, the gear indicator flashes the number of the new gear.

When the shift is complete, the new gear displays solid, without flashing.

Automatic Mode (AUTO)

In automatic drive mode (AUTO), upshifts and downshifts are made by the transmission without driver intervention. Press in the neutral lock button, move the selector switch to drive (D), and press down on the throttle pedal. The transmission will shift automatically.

If driving conditions require, it is still possible to request a manual shift. The transmission will make the shift if the engine speed is within 75 rpm of the load-based shift point for that gear.

If the driver presses down on the throttle pedal after a manual downshift in automatic mode, the transmission will upshift again if the UltraShift TCU requires it.

Manual Mode (MAN)

In manual drive mode (MAN), upshifts and downshifts are made by the driver:

- To shift up, pull the lever up (towards you).
- To shift down, push the lever down (away from you).

The system will hold the current gear until the driver requests a shift. In downhill situations in particular, the driver must be alert to vehicle speed by downshifting and/or using the service brake.

A shift request will still be refused if the selected gear would cause engine overspeed or excessive lugging.

Selecting Gears

Reverse

Reverse (R) is at the upper end of the four-position selector switch located at the end of the SmartShift control lever. To select R, press in the neutral lock button and move the selector switch upward to the position above neutral.

Six-speed UltraShift ASW has one reverse gear. When reverse is selected, the letter "R" displays on the gear indicator. See **Fig. 8.17**.

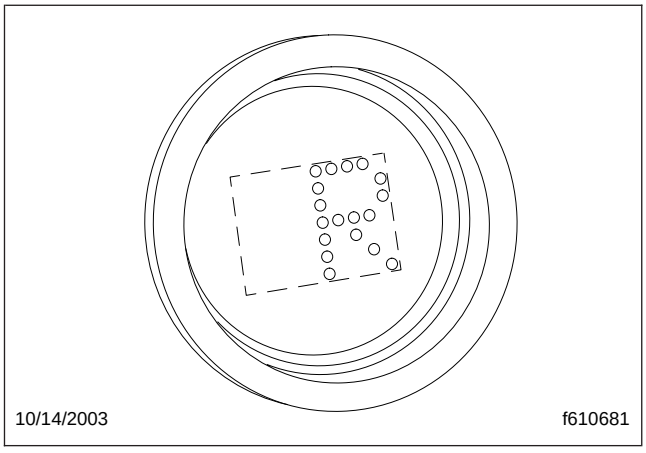


Fig. 8.17, Reverse Gear Display

Ten-speed UltraShift DM has two reverse gears, reverse low and reverse high. To shift manually between them, use the shift lever as described for MAN mode. There is no AUTO mode for reverse.

When reverse low is selected, the letter "R" displays on the current gear indicator. When reverse high is selected, the letter "H" displays on the current gear indicator.

IMPORTANT: Under normal conditions, do not select reverse with the vehicle moving forward.

The vehicle must be moving at less than two miles per hour (3 km/h) before selecting reverse. If reverse is selected when the vehicle is moving faster, an audible alert will sound and continue sounding at three-second intervals until the control lever is returned to the D position. When the vehicle is moving at the proper speed, reverse can be engaged.

On ten-speed UltraShift DM only, if necessary to rock the vehicle, use the selector switch to shift back and forth at low speed between reverse and drive.

Neutral

IMPORTANT: Always start the engine with the transmission in neutral, the parking brake set, and the service brakes applied.

Neutral (N) is directly below R on the four-position selector switch located at the end of the SmartShift control lever. To select N, move the selector switch to the position below R. When neutral is selected, the letter "N" displays on the gear indicator. See **Fig. 8.18**.

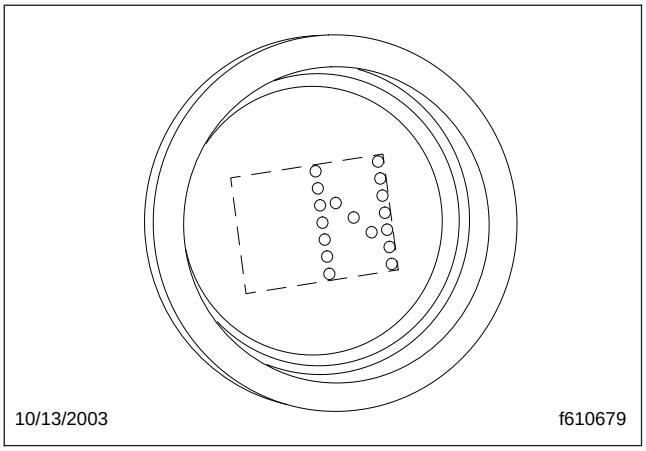


Fig. 8.18, Neutral Display

⚠ WARNING

Do not coast in neutral. Coasting in neutral can cause an accident, possibly resulting in severe personal injury or death.

Neutral is always available during operation, whatever the vehicle speed. When in neutral, requests to upshift or downshift are ignored. If the selector switch is moved from neutral to drive while the vehicle is moving, the transmission will shift into a gear within the engine's operating speed range.

When shifting from neutral, always press on the brake pedal. If the brake pedal is not pressed, the transmission will not shift, the current gear display will flash "N," and an audible alert will sound.

NOTE: To reset the transmission, return the selector switch on the SmartShift lever to N and attempt the shift again, this time with the brake pedal pressed.

Before shutting down the engine, return the selector switch to "N." When the ignition is turned off, the transmission will reset to neutral in a few minutes regardless of the position of the shift lever.

Drive

Drive (D) is directly below N on the four-position selector switch located at the end of the SmartShift control lever. To select D, press in the neutral lock button and move the selector switch to the position below N. When drive is selected, the number of the currently selected forward gear (1 through 6 on six-speed UltraShift ASW; 1 through 10 on ten-speed UltraShift DM) displays on the gear indicator. See **Fig. 8.16**.

When in drive, requests to upshift or downshift are enabled. Either manual or automatic mode can be selected on the slide switch.

Two starting gears are available, first and second. The default starting gear is second, but first can be selected by the driver, if desired. To change the starting gear, press the brake pedal and select D with the vehicle stopped. The current gear indicator will display the starting gear. Move the shift lever up or down until the desired starting gear is displayed.

The UltraShift TCU adapts to the working conditions of each vehicle and its driver. After power-up or a load change, it needs to learn the new conditions.

While learning, it may hold a gear too long before upshifting. Start the upshift manually. It may take three or four shifts before UltraShift succeeds in learning the new load-based shift points, but after that it will handle the shifting automatically.

Low

Low (L) is located at the lower end of the four-position selector switch located at the end of the SmartShift control lever. To select L, press in the neutral lock button and move the selector switch to the position below D.

When in low, the current gear is maintained. Requests to upshift are not enabled.

IMPORTANT: If the engine is approaching overspeed, the UltraShift TCU will override the current gear setting and upshift to prevent engine damage.

To enhance engine braking, downshifts are performed at higher rpm than normal.

If L is selected from neutral while stopped, the vehicle starts up in first gear and stays there until the engine approaches overspeed.

Upshifting

To request an upshift with the transmission in drive, pull the control lever up (towards you). If the gear is available, the transmission upshifts and the new gear displays on the gear indicator. No skip shifts are available while upshifting.

No upshifts are available in low, except to prevent engine overspeed.

If the transmission does not upshift quickly enough after power-up or a load change, begin the shift manually. The UltraShift TCU will learn the new load-based shift conditions after three or four shifts.

If the gear requested is unavailable, a tone will sound. An unavailable request to upshift is not stored in memory. The upshift must be requested again.

Downshifting

NOTE: The driver can manually downshift at any time, even when the slide switch is set to AUTO mode.

To request a downshift with the transmission in drive or low, push the control lever down (away from you). If the gear is available, the transmission downshifts and the new gear displays on the gear indicator. Skip shifts are available while downshifting.

For best engine braking, select low while moving. In low, downshifts are performed at higher rpm than in drive.

IMPORTANT: If the engine is approaching overspeed, the UltraShift TCU will override the current gear setting and upshift to prevent engine damage.

If the gear requested is unavailable, a tone will sound. An unavailable request to downshift is not stored in memory. The downshift must be requested again.

When coasting to a stop, the UltraShift TCU may not finish the downshift until the driver presses down on the throttle pedal again.

IMPORTANT: A downshift request can never result in a shift into neutral, even if the vehicle is in the drive position in the lowest possible gear.

Before starting down a hill, slow down. Downshift to a speed that you can control without hard pressure on the service brakes.

Before entering a curve, slow down to a safe speed. Downshift if necessary. This lets you use some power through the curve to help the vehicle be more stable on the turn. It also allows you to regain speed faster as you come out of the curve.

UltraShift Diagnostics

Clutch Calibration

NOTE: Clutch calibration only occurs on six-speed UltraShift ASW.

The UltraShift TCU automatically adjusts for clutch wear. The calibration takes place whenever the following conditions are met:

- The engine is at normal operating temperature
- The vehicle is stopped
- The engine is at idle speed
- The selector switch on the control lever is in neutral

Calibration may take up to two minutes to complete. The engine may slow and return to normal idle several times during calibration.

To stop calibration at any time, select one of the drive positions on the selector switch (R, D, or L).

Clutch Protection Fault

Excessive clutch slippage creates heat and reduces the life of the clutch. These are some conditions which lead to clutch abuse:

- Using the throttle to hold the vehicle on a grade
- Starting the vehicle in too high a gear
- Overloading the vehicle
- Using high idle with the vehicle in gear

The UltraShift TCU is programmed to prevent clutch abuse. When the clutch overheats, the following alerts take place:

- The "TRANS TEMP" light comes on
- The gear indicator displays "CA"
- A warning tone sounds at one second intervals

The alerts continue until the clutch cools, the throttle is released, or the clutch is fully engaged.

System Problem

In the event of a problem, do the following steps:

1. Note the driving conditions at the time the problem occurred.
2. Record the status of the transmission at the time of the problem (AUTO or MAN mode, gear setting R, N, D, or L, current gear, engine speed, etc.)
3. Reset the system, using the procedure below.

Reset Procedure

Transmission operation can sometimes be restored by doing the following reset procedure:

1. Stop the vehicle when it is safe to do so.
2. Place the selector switch in neutral and turn off the ignition.
3. Check all harness connectors as described in **Chapter 11**.
4. Wait at least two minutes with the engine shut down.
5. Restart the engine.

If the problem continues, contact an authorized Freightliner or Eaton service facility.

Locked In Gear

If the transmission becomes locked in gear, a dash (–) will appear on the gear indicator when the vehicle is restarted during the reset procedure.

NOTE: If the transmission becomes locked in gear while the vehicle is moving, increased braking effort may be required to stop the vehicle.

If the current gear indicator displays a dash during power-up with the selector switch in neutral, do the following steps:

1. Make sure the parking brake is set.
2. Turn off the ignition and wait at least two minutes.
3. Apply the service brakes.
4. With the service brakes applied, release the parking brake.
5. Make sure the selector switch is in neutral and turn on the ignition key. Do not attempt to start the engine at this time.
6. If necessary to get the transmission to shift into neutral, release the pressure on the brake pedal slightly.
7. Once the UltraShift TCU reaches neutral, a solid "N" will appear on the current gear indicator and the vehicle will start. Make sure the service brakes are applied and the parking brake is set.

If the gear indicator continues to display a dash, contact an authorized Freightliner or Eaton service facility.

Mercedes-Benz Manual Transmissions

CAUTION

Operating a manual transmission with the fluid level higher or lower than recommended can result in transmission damage.

Mercedes-Benz transmissions use a simple 6-speed gear pattern as shown in **Fig. 8.19**.

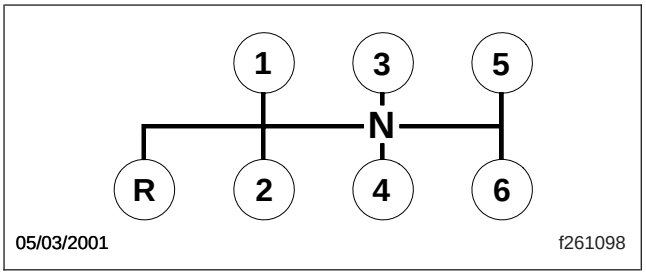


Fig. 8.19, Shift Pattern, M-B Transmissions

Always use first gear when starting to move the vehicle forward.

IMPORTANT: Do not rest your foot on the clutch pedal while driving. This causes partial clutch disengagement which could cause premature clutch wear.

While traveling, check the tachometer regularly to be sure the engine speed is within the most economical range (1400 to 2000 rpm).

On level roads, drive in the highest usable gear, keeping engine speed down.

CAUTION

Do not rest your hand on the gear shift lever while driving. This can cause synchronizer damage.

When approaching an uphill grade, shift down ahead of time to prevent loss of engine rpm. When approaching a downhill grade, shift down ahead of time to prevent runaway speed. For information about shift points and "progressive shifting," see **Chapter 7**.

Change gears only when absolutely necessary. Skip gears if needed.

When shifting, always press the clutch pedal all the way down. Do not force the gear lever.

Before shifting into reverse, be sure the engine is idling and the vehicle is not moving.

CAUTION

If the transmission locks up while driving, making further shifting impossible, continue driving in the gear already selected to reach service assistance, as circumstances allow. Or, safely park the vehicle off the roadway and contact your nearest Freightliner dealer or other qualified service provider for roadside assistance. To prevent further transmission damage, do not move the vehicle from a standing start unless this can be accomplished safely, taking into account the gear that is engaged and the load on the vehicle.

Mercedes-Benz Automated Transmissions

General Information, AGS

The AGS Automated Gear Shift is a fully automated 6-speed medium-duty transmission. The clutch is activated by a hydraulic system that is integral to the transmission. No clutch pedal is needed to operate the vehicle.

AGS transmissions use the SmartShift control lever on the steering column to select gears. A manual shift is possible at any time by moving the SmartShift lever up or down as needed.

The transmission control unit (TCU) can direct all forward shifts in response to driving conditions and the driver's pressure on the brake and throttle pedals. To know which gear the transmission is in, look at the round current gear indicator on the right-hand control panel as shown in **Fig. 8.12**.

The TCU always selects first gear to start the vehicle in motion. It is possible, in manual mode, to start an unloaded or lightly loaded vehicle in second gear. In most cases, second gear is acceptable for downhill starts. In other situations, for best results always start moving in first gear. Loaded vehicles, or vehicles on substantial grades, must start moving only in first gear.

⚠ CAUTION

At the first sign of a transmission malfunction, take the vehicle out of service immediately. Depending on the type of problem, further shifting may not be possible, and driveline torque may be interrupted.

Operation, AGS

Power Up

1. With the parking brake set and/or the brake pedal pressed down, select neutral (N) by moving the selector switch to the center position.
2. With the transmission in neutral, turn on the ignition switch. The "CHECK TRANS" and "TRANS TEMP" telltale lights come on and go out again (bulb check). See **Fig. 8.13**.
3. On power up, the current gear indicator shows the dot display, arranged in a square pattern. All dots in the pattern should light up, without gaps or spaces. See **Fig. 8.14**.
4. When the current gear indicator shows "N," start the engine.

NOTE: No matter what the circumstances, do not start the engine unless the current gear indicator shows "N." See **Chapter 13** for jump starting information.

5. Select drive (D) by pressing in the neutral lock button and moving the selector switch downward to the position below neutral. Release the parking brake and/or service brake pedal. The gear is displayed on the current gear indicator.

NOTE: When D is selected, the transmission starts up in first gear. To start up in second gear (downhill start, vehicle unloaded or lightly loaded), pull up on the SmartShift lever when the current gear indicator displays "1."

6. On a level grade, press down on the throttle pedal to allow the vehicle to move forward. The vehicle will not move until the pedal is depressed.

⚠ WARNING

When starting or stopping on hills and grades, use extra care to prevent the vehicle from rolling back. A rollback accident could cause death, serious personal injury, or property damage.

7. Prevent the vehicle from rolling backwards when stopped on a hill or grade, or when the vehicle is starting from a stop on a hill or grade.

   7.1 *To start from a full stop on a hill or grade*, quickly move your foot from the brake pedal and press firmly on the throttle pedal.

   On steep hills, set the parking brake and release it only when there is enough engine power to prevent rollback.

   7.2 *To stop on a hill or grade*, press and hold the brake pedal to keep the vehicle from moving.

   On steep hills, set the parking brake. Never hold a hill with the throttle pedal. This will cause the clutch to overheat.

Power Down

1. Bring the vehicle to a complete stop.
2. Set the parking brake.
3. Move the selector switch to N. Wait until "N" appears on the current gear indicator.

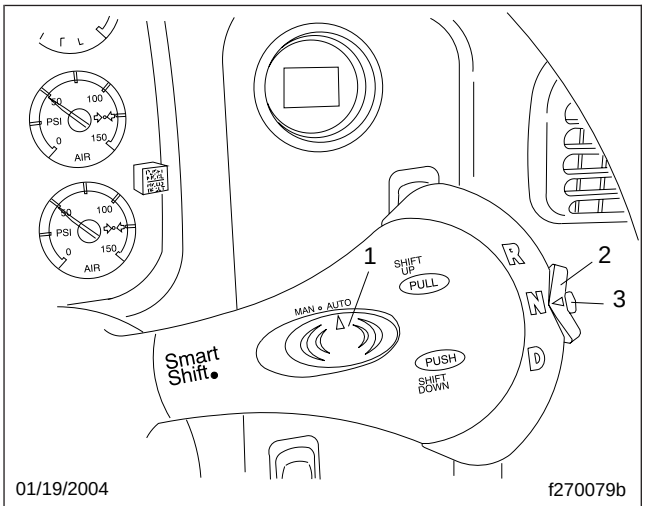
⚠ WARNING

Always apply the parking brake before shutting down the engine. AGS will shift into neutral after shutdown, regardless of the position of the shift lever. If you do not set the parking brake, the vehicle could roll and cause an accident resulting in death, serious personal injury, or property damage.

4. Turn the ignition switch off and shut down the engine.
5. If the current gear indicator flashes "PB" when the engine is shut down, set the parking brake and move the selector switch to "N."

Automatic and Manual Modes

The SmartShift control has a slide switch located on the body of the lever just before the paddle widens out. See **Fig. 8.20**. The slide switch controls the forward driving mode, automatic or manual.



1. Slide Switch (controls forward driving mode)
2. Selector Switch (controls gear selection)
3. Neutral Lock Button (prevents accidental shift into gear)

Fig. 8.20, Switches, AGS Transmissions

To change mode at any time, move the slide switch in the desired direction. This allows the driver to respond to a wide range of driving conditions, such as blind corners, tight curves, and steep hills.

IMPORTANT: Whatever the mode, it is always possible to shift manually by moving the lever up or down as needed.

In either mode, the gear indicator displays the current gear. See **Fig. 8.16**.

Automatic Mode (AUTO)

Automatic drive mode (AUTO) is recommended for most driving conditions. For the best fuel economy, always use AUTO mode.

In AUTO mode, upshifts and downshifts are made by the transmission without driver intervention. Press in the neutral lock button, move the selector switch to drive (D), and press down on the throttle pedal. The transmission will shift automatically through the forward gears.

If driving conditions require, it is still possible to request a manual shift. The transmission will make the shift unless the selected gear would cause engine overspeed.

If the driver presses down on the throttle pedal after a manual downshift in automatic mode, the transmission will upshift again if the TCU requires it.

On downgrades, the transmission holds the current gear until the driver requests a shift, or presses the throttle pedal.

⚠ WARNING

While driving off-road or with locked differential in AUTO mode, use extra caution. Shifts of the AGS could interrupt power to the drive wheels, causing a rollback accident while climbing steep grades at low speeds. A rollback accident could cause death, serious personal injury, or property damage.

Manual Mode (MAN)

Manual mode may be required under certain conditions, such as:

- In difficult or slippery conditions
- On hills, steep grades, or other situations where driveline torque interruption is not desirable
- During off-road driving or driving with a locked differential
- In downhill driving where control of engine braking is needed
- If necessary to hold a specific gear on a downgrade

In manual drive mode (MAN), upshifts and downshifts are made by the driver:

- To shift up, pull the lever up (towards you).
- To shift down, push the lever down (away from you).

The system will hold the current gear until the driver requests a shift. In downhill situations in particular, the driver must be alert to vehicle speed and maintain vehicle control by downshifting and/or using the service brakes as needed.

When braking or slowing in MAN, downshift as necessary to prevent lugging the engine when speed is resumed. If the vehicle comes to a complete stop, the TCU resets the transmission to neutral.

NOTE: A downshift request will be refused if the selected gear would cause engine overspeed.

Cruise Control

Cruise control is fully functional with AGS transmission in either AUTO or MAN mode.

In AUTO, the TCU will adjust the gear selections to maintain the speed settings as desired. No driver action is necessary.

In MAN, the vehicle speed settings must be within the engine speed range for the gear selected. If the engine cannot maintain set speed due to changes in road grade, the driver must downshift or upshift as necessary.

For vehicles equipped with a power take-off (PTO) unit, two modes of operation are possible, stationary and mobile. For PTO operation, see **Chapter 7**.

Selecting Gears

Reverse

Reverse (R) is at the upper end of the three-position selector switch located at the end of the SmartShift control lever. To select reverse (R), press in the neutral lock button and move the selector switch upward to the position above neutral. When reverse is selected, the letter "R" displays on the gear indicator. See **Fig. 8.17**.

IMPORTANT: The vehicle must come to a complete stop before selecting reverse. If reverse is selected with the vehicle moving forward, an audible alert will sound and continue sounding at three-second intervals until the selector switch is returned to N or D.

Once the vehicle has come to a complete stop, reverse can be engaged.

Neutral

Neutral (N) is in the center of the three-position selector switch located at the end of the SmartShift control lever. Always start the engine in neutral. To select neutral, move the selector switch to the center position. When neutral is selected, the letter "N" displays on the gear indicator. See **Fig. 8.18**.

⚠ WARNING

Do not coast in neutral. Coasting in neutral can cause an accident, possibly resulting in severe personal injury or death.

Neutral is always available during operation, whatever the vehicle speed. When in neutral, requests to upshift or downshift are ignored. If the selector switch is moved from neutral to drive while the vehicle is moving, the transmission will shift into a gear within the operating torque range of the engine.

⚠ WARNING

Always apply the parking brake before shutting down the engine. AGS will shift into neutral after shutdown, regardless of the position of the shift lever. If you do not set the parking brake, the vehicle could roll and cause an accident resulting in death, serious personal injury, or property damage.

Before shutting down the engine, return the selector switch to "N." When the ignition is turned off, the transmission will reset to neutral during power down.

Drive

IMPORTANT: The vehicle must come to a complete stop before selecting drive. If drive is selected with the vehicle moving in reverse, an audible alert will sound and continue sounding at three-second intervals until the selector switch is returned to N or R.

Drive (D) is at the lower end of the three-position selector switch located at the end of the SmartShift control lever. To select drive, press in the neutral lock button and move the selector switch to the position below neutral. When drive is selected, the number of the currently selected forward gear (1, 2, 3, 4 , 5, or 6) displays on the gear indicator.

Upshifting

NOTE: The driver can manually upshift at any time, even when the slide switch is set to AUTO mode.

To request an upshift with the transmission in drive, pull the control lever up (towards you). If the gear is

available, the transmission upshifts and the new gear displays on the gear indicator.

As in a manual transmission, upshifting too early causes engine lugging and uneven operation.

To achieve smooth operation in MAN mode, upshift when the engine speed reaches approximately 2000 revolutions per minute (rpm). Heavy loads or steep grades require higher rpm; lighter loads require lower rpm.

An unavailable request to upshift is not stored in memory. The upshift must be requested again.

Downshifting

NOTE: The driver can manually downshift at any time, even when the slide switch is set to AUTO mode.

To request a downshift with the transmission in drive, push the control lever down (away from you). If the gear is available, the transmission downshifts and the new gear displays on the gear indicator.

Downshifts are not available if the engine speed after the shift would exceed 2700 rpm. If the gear requested is unavailable, an audible alert will sound. An unavailable request to downshift is not stored in memory. The downshift must be requested again.

To achieve smooth operation in MAN mode, downshift when the engine speed reaches approximately 1200 rpm.

Before starting down a hill, slow down. Downshift to a speed that you can control without hard pressure on the service brakes.

Before entering a curve, slow down to a safe speed. Downshift if necessary. This lets you use some power through the curve to help the vehicle be more stable when turning. It also allows you to regain speed faster as you come out of the curve.

AGS Diagnostics

⚠ CAUTION

At the first sign of a transmission malfunction, take the vehicle out of service immediately. Depending on the type of problem, further shifting may not be possible, and driveline torque may be interrupted.

System Malfunction

If the "CHECK TRANS" telltale light comes on while driving, the audible alert sounds, and the current gear indicator begins to flash between the current gear and "SM" (system malfunction), there is a problem which may or may not be apparent to the driver. Bring the vehicle at once to a safe stopping place and call an authorized Freightliner service facility for assistance.

Clutch Overload

If the "TRANS TEMP" telltale light comes on while driving and the current gear indicator begins to flash between the current gear and "CO" (clutch overload), the clutch has begun to overheat.

The clutch overload may have been caused by improper driving practices such as frequent and rapid start/stop driving, or hillholding with the throttle pedal. In this case, allow the clutch to cool, and continue on, but cease the improper driving practices.

If the clutch overload message returns or continues, the clutch is worn or damaged. Bring the vehicle at once to a safe stopping place and call an authorized Freightliner service facility for assistance.

Low Hydraulic Fluid Level

IMPORTANT: The only hydraulic fluid permitted in this system is Pentosin CHF 11S. No other fluid can be substituted.

If the "CHECK TRANS" telltale light comes on while driving and the current gear indicator begins to flash between the current gear and "FL" (fluid level), there has been an unusual loss of hydraulic fluid. Bring the vehicle at once to a safe stopping place and call an authorized Freightliner service facility for assistance. The hydraulic reservoir holds about 1.05 quarts (one liter) of Pentosin CHF 11S.

NOTE: After hydraulic fluid loss, a special procedure is required to fill the hydraulic reservoir. This procedure must be carried out by an authorized Freightliner service facility.

Meritor™ Drive Axles

Refer to the Meritor website for additional information, **www.arvinmeritor.com**.

Drive Axles With Differential Lock

The Meritor driver-controlled differential lock feature (side-to-side wheel lock, traction control, or traction equalizer) is available on single-drive or dual-drive rear axles. It is available on both axles of a dual-drive vehicle, or on one only. It is only available on drive axles. Differential lock must only be used under adverse road conditions where greater traction is needed. With differential lock on, the turning radius is increased and vehicle handling is affected. The differential lock switch (**Fig. 8.21**) allows the driver to lock the wheels on the same axle together. The red differential lock warning light illuminates on the dash message center when differential lock is engaged.

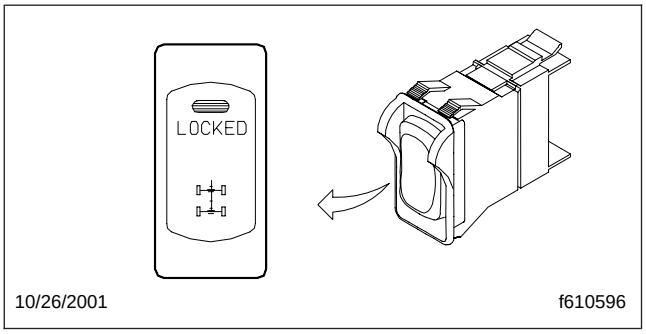


Fig. 8.21, Differential Lock Switch

Differential lock provides maximum traction under slippery conditions. When the differential lock is engaged, the clutch collar completely locks the differential case, gearing, and axle shafts together, maximizing the traction of both wheels and protecting against spinout.

Under normal traction conditions, do not use the differential lock feature.

Differential Lock Switch

CAUTION

Differential lock should only be engaged when the vehicle is stopped or moving slowly at low throttle. This will prevent internal axle damage.

Normally, when differential lock is available on dual-drive vehicles, one switch activates the lock on both rear drive axles. As an option, it possible to have two differential lock switches, one for the forward rear and one for the rearmost drive axle. It is also possible for some vehicles to have differential lock on only one of the drive axles.

A two-position guarded rocker switch (**Fig. 8.21**) controls differential lock, causing the wheels on each axle governed by the switch to rotate together. To lock the wheels together, press the upper half of the rocker momentarily (at the red LED). To unlock the wheels, press the upper half of the rocker again.

IMPORTANT: The differential lock rocker switch is guarded to prevent unintentional switch activation. If the LED in the switch begins to blink during normal operation, when the switch has not been activated, this indicates an error condition. Bring the vehicle to an authorized Freightliner service facility as soon as possible.

When the differential lock switch is pressed, three responses are possible: a normal response, a slow response, and an abnormal response.

Normal Response: The LED in the switch blinks until the axle has responded to the request to lock the wheels. At this point, the LED comes on steady and stays illuminated. In normal operation, the wheels may lock so quickly that the blinking of the switch is barely noticeable.

If operation of the switch is not possible for any reason (ignition is turned off, vehicle is moving faster than 25 mph, etc.), the LED will stop blinking and turn off.

Slow Response: If operation of the switch is slowed for any reason (vehicle moving too fast, low air pressure, etc.), the switch will continue to blink until the wheels are able to lock. As in the normal response, the LED comes on steady and stays illuminated once the wheels have locked.

NOTE: If the vehicle is moving too fast, let up slightly on the accelerator. As the vehicle slows, the wheels will lock.

Abnormal Response: If the LED blinks for more than 30 seconds, the lock mechanism may not be fully engaged/disengaged. Bring the vehicle to an authorized Freightliner service facility for testing.

Differential Lock Operation

WARNING

Locking the wheels when the vehicle is traveling down steep grades or when the wheels are slipping could damage the differential and/or lead to loss of vehicle control, causing personal injury and property damage.

Lock the wheels only when the vehicle is standing still or moving at very low speed, less than 5 mph (8 km/h). Never lock the wheels when the vehicle is traveling down steep grades or when the wheels are slipping.

NOTE: On some vehicles, the differential lock system is connected through the low speed range of the transmission. If this system is used, the transmission must be in the low speed range for the wheels to fully lock.

WARNING

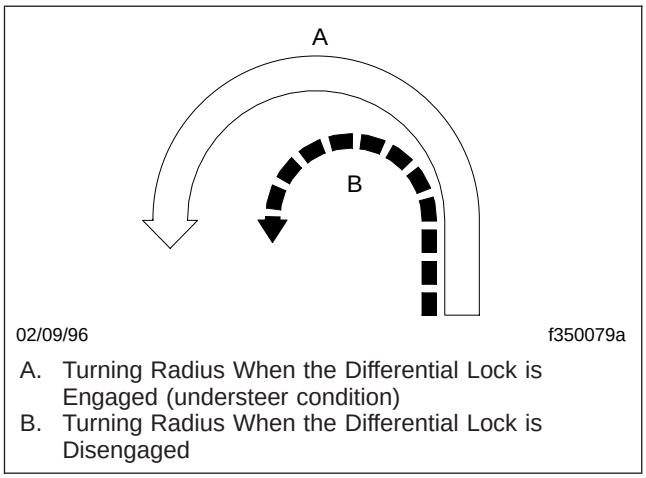
A vehicle with locked wheels can still slip sideways, causing possible loss of vehicle control, personal injury, and property damage.

Be especially careful when driving under slippery conditions with the wheels locked. Though forward traction is improved, the vehicle can still slip sideways.

If the vehicle is moving, maintain a constant vehicle speed when the differential lock is turned on. Briefly let up on the accelerator to relieve torque on the gearing, allowing the wheels to lock completely. When the wheels are fully locked, the turning radius will increase because the vehicle understeers. See **Fig. 8.22**. Drive cautiously and do not exceed 25 mph (40 km/h).

To disengage differential lock after leaving poor road conditions, operate the differential lock switch as discussed above while maintaining vehicle speed. Let up momentarily on the accelerator to allow the wheels to fully unlock, then resume driving at normal speed.

NOTE: If the differential lock system is connected with the transmission in its low speed range, shifting out of the low speed range will also disengage the differential lock function. The switch will blink until the wheels unlock, and then go out.



A. Turning Radius When the Differential Lock is Engaged (understeer condition)
B. Turning Radius When the Differential Lock is Disengaged

Fig. 8.22, Turning Radii

Tandem Drive Axles With Interaxle Lock

CAUTION

The interaxle lock should not be engaged on a vehicle with obviously spinning wheels. Engagement at high speed or power can damage the axle(s).

Meritor has an interaxle lock (axle lock, interaxle differential lockout) feature that is standard on all dual-drive (tandem-drive) vehicles. Interaxle lock is recommended for use under adverse road conditions where greater traction is needed. See the axle manufacturer's manual provided with the vehicle for more information.

The interaxle lock switch (**Fig. 8.23**) allows the driver to lock both rear axles together. The red interaxle warning light illuminates on the dash message center when interaxle lock is engaged.

When the interaxle lock is not engaged, there is differential action between the two axles. The differential compensates for different wheel speeds and variations in tire size. Keep the interaxle lock disengaged when driving on roads where traction is good.

When the interaxle lock is engaged, the differential action between the two axles is locked. Both drive axles now share the power. Both axles, and both

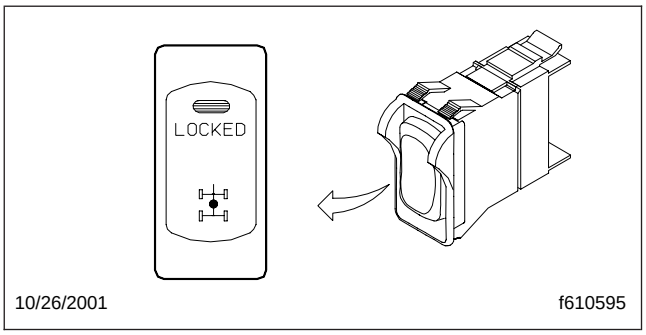


Fig. 8.23, Interaxle Lock Switch

sets of wheels, turn together at the same speed. The interaxle lock should be used when the vehicle encounters poor traction conditions; however, it also increases drivetrain and tire wear and should be used only when improved traction is required.

Interaxle Lock Switch

A two-position guarded rocker switch (**Fig. 8.23**) controls interaxle lock, causing both axle shafts to rotate together. To lock the axles together, press the upper half of the rocker momentarily (at the red LED). To turn off interaxle lock, press the lower half of the rocker (at the double-axle icon).

IMPORTANT: The interaxle lock rocker switch is guarded to prevent unintentional switch activation. This switch does not have a diagnostic blink function when inactive.

When the interaxle lock switch is pressed, three responses are possible: a normal response, a slow response, and an abnormal response.

Normal Response: The LED in the switch blinks until the interaxle lock is engaged. At this point, the LED comes on steady and stays illuminated. In normal operation, the interaxle may lock so quickly that the blinking of the switch is barely noticeable.

If operation of the switch is not possible for any reason (ignition is turned off, vehicle is moving too fast, etc.), the LED will stop blinking and turn off.

Slow Response: If operation of the switch is slowed for any reason (by cold weather, low air pressure, etc.), the switch will continue to blink until the axles lock together, or for a maximum of 10 seconds. As in the normal response, the LED comes on steady and stays illuminated.

Abnormal Response: If the LED blinks for more than 30 seconds, the lock mechanism may not be fully engaged/disengaged. Bring the vehicle to an authorized Freightliner service facility for testing.

Interaxle Lock Operation

To engage interaxle lock and achieve maximum pulling power in slippery or hazardous road conditions, operate the interaxle lock switch as discussed above, while maintaining vehicle speed. Let up momentarily on the accelerator until the axle lock engages. Proceed over poor road conditions with caution. Do not wait until traction is lost and the tires are spinning before engaging the interaxle lock.

⚠ CAUTION

Do not turn on the interaxle lock switch when the tires are slipping. Do not continuously operate the vehicle with the interaxle lock engaged during good road conditions. To do so could result in damage to the axle gearing and excessive tire wear.

To disengage the interaxle lock after leaving poor road conditions, operate the interaxle lock switch as discussed above while maintaining vehicle speed. Let up momentarily on the accelerator to allow the axles to fully unlock, then resume driving at normal speed.

Axle Shift

⚠ CAUTION

To prevent transmission and axle damage, make sure the automatic transmission is in high range when performing an axle shift with the vehicle moving.

Axle shift is a function installed on vehicles with two-speed axles to allow the use of the low speed range when greater traction and maximum pulling power is needed at low engine speed (rpm).

Under normal operating conditions, the vehicle is operated using the high-speed gear ratios of the axle. Under extreme weather or off-road conditions, at low speed and rpm and/or to pull heavy loads, the vehicle must be operated using the low-speed, or reduction, gear ratios of the axle.

Axle Shift Switch

The axle shift switch is a two-position guarded rocker switch (**Fig. 8.24**) installed on vehicles with two-speed axles.

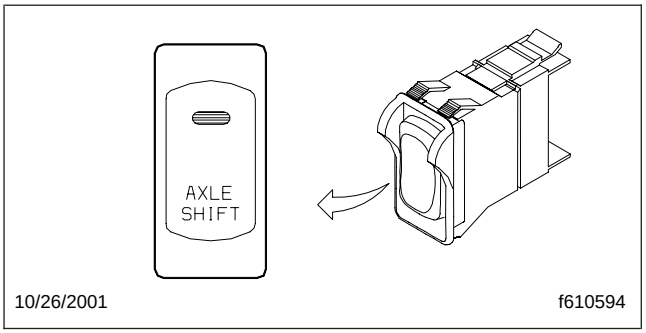


Fig. 8.24, Axle Shift Switch

To shift the axle from low speed to high speed, press the upper half of the rocker momentarily (at the LED). To turn the axle shift off (switch from high speed back to low speed), press the upper half of the rocker again. When the axle has shifted speed, the LED turns off.

When the panel lights are on, the AXLE SHIFT legend is backlit in green.

IMPORTANT: The axle shift rocker switch is guarded to prevent unintentional switch activation. If the LED in the switch begins to blink during normal operation, when the switch has not been activated, this indicates an error condition. Bring the vehicle to an authorized Freightliner service facility as soon as possible.

When the axle shift switch is pressed, three responses are possible: a normal response, a slow response, and an abnormal response.

Normal Response: The LED in the switch blinks until the axle shifts speed. At this point, the LED comes on steady and stays illuminated. In normal operation, the axle may shift so quickly that the blinking of the switch is barely noticeable.

If operation of the switch is not possible for any reason (interaxle lock is on, ignition is turned off, etc.), the LED will stop blinking and turn off.

Slow Response: If operation of the switch is slowed for any reason (by cold weather, low air pressure, etc.), the switch will continue to blink until the axle shifts. As in the normal response, the LED comes on steady and stays illuminated.

Abnormal Response: If the LED blinks for more than 30 seconds, the axle shift function/mechanism may not be operating correctly. Bring the vehicle to an authorized Freightliner service facility for testing.

Axle Switch Interlock

NOTE: On vehicles with tandem drive axles, there is an interlock that prevents an axle from shifting speed whenever the interaxle lock is on.

If the axle shift switch is pressed when the interaxle lock is on, the axle shift will not be completed. The LED does the following:

- If the LED is off, the LED comes on briefly and turns off again.
- If the LED is on, it stays on.

To complete the axle shift, turn off the interaxle lock and press the axle shift switch again. If still needed, the interaxle lock can then be reactivated.

9

Steering and Brake Systems

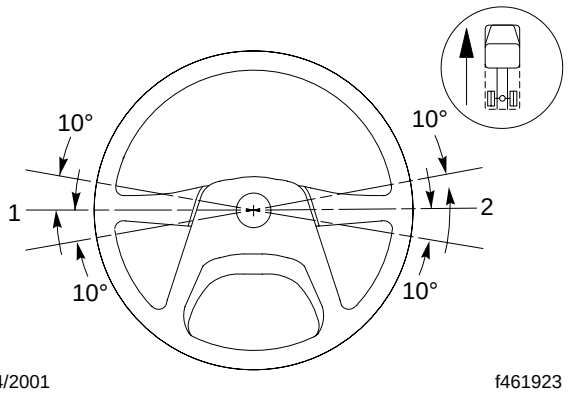
Steering System 9.1
Air Brake System 9.1
Hydraulic Brake System 9.6

Steering System

Steering Wheel Adjustment

Two steering wheels are available: a standard 18-inch (450-mm) steering wheel and an optional 20-inch (500-mm) steering wheel.

When there is no load on the vehicle and the front tires are pointed straight ahead, the standard steering wheel spokes should be at the 3 o'clock and 9 o'clock positions or within 10 degrees of these positions. See **Fig. 9.1**.



NOTE: The standard steering wheel is shown.

1. 9 o'Clock
2. 3 o'Clock

Fig. 9.1, Steering Wheel Centered

On the optional 20-inch (500-mm) wheel, the steering wheel spokes should be at the 4 o'clock and 8 o'clock positions or within 10 degrees of these positions. For steering wheel adjustment procedures, see **Group 46** of the *Business Class® M2 Workshop Manual*.

Power Steering System

The power steering system consists of a steering gear (which includes a manual steering mechanism, a hydraulic control valve, and a hydraulic power cylinder), hydraulic hoses, power steering pump, power steering reservoir, and other components. Some models are also equipped with a separate hydraulic power cylinder on the right side of the front axle.

The power steering pump, driven by the engine, provides the power assist for the steering system. If the engine is not running, there is no power assist.

If the power-assist feature does not work due to hydraulic fluid loss, steering pump damage, or some other cause, bring the vehicle to a safe stop. Do not drive the vehicle until the cause of the problem is corrected.

⚠ WARNING

Driving the vehicle without the power-assist feature of the steering system requires much greater effort, especially in sharp turns or at low speeds, which could result in an accident and possible injury.

Drivers should use the power available with a power steering system carefully. If the front tires become lodged in a deep chuckhole or rut, drive the vehicle out instead of using the steering system to lift the tires from the hole. Avoid turning the tires when they are against a curb as this places a heavy load on steering components and could damage them.

Air Brake System

A dual air brake system consists of two independent air brake systems that use a single set of brake controls. Each system has its own reservoir, plumbing, and brake chambers. The primary air system operates the service brakes on the rear axle; the secondary air system operates the service brakes on the front axle. Service brake signals from both systems are sent to the trailer.

Primary Air Brake System

Loss of air pressure in the primary air system causes the rear service brakes to become inoperative. The front brakes will continue to be operated by the secondary air system. In addition, the trailer brakes (if equipped) will be operated by the secondary air system.

Secondary Air Brake System

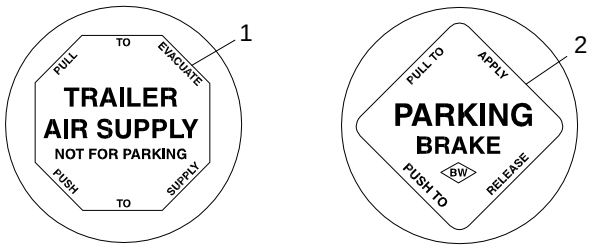
Loss of air pressure in the secondary air system causes the front axle brakes to become inoperative. The rear service brakes will continue to be operated by the primary air system. In addition, the trailer brakes (if equipped) will be operated by the primary air system.

Emergency Braking System

When air pressure is lost in either the primary or secondary air system, the air compressor will operate, but the air supply in the other system, the one that is not leaking, will not be replenished. There will be enough air in the other system to stop the vehicle safely. The dual air brake system thus provides emergency braking capability. When the low air pressure warning light and emergency buzzer first come on, stop the vehicle immediately. Do not drive the vehicle until the cause of the problem is corrected.

Parking Brakes, Tractor and Trailer

The yellow diamond-shaped knob (parking brake control valve) on the auxiliary dash panel applies the parking brakes (spring brakes). Pulling out the knob applies both the tractor and the trailer parking brakes and automatically causes the red octagonal knob (trailer air supply valve) to pop out. See **Fig. 9.2**.



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1. Trailer Air Supply Valve (red knob)
2. Parking Brake Control Valve (yellow knob)

Fig. 9.2, Brake Valve Control Knobs

The red octagonal-shaped knob on the auxiliary dash panel operates the trailer air supply valve. After the vehicle and its air hoses are connected to a trailer, and the pressure in the air system is at least 65 psi (448 kPa), the red knob must be pushed in (and should stay in) to charge the trailer air supply system and release the trailer parking brakes. Before disconnecting a trailer or when operating a vehicle without a trailer, the red knob must be pulled out.

If pressure in both air systems drops to 35 to 45 psi (241 to 310 kPa), the red knob automatically pops out, exhausting the trailer air supply and applying the trailer parking brakes.

If the trailer is not equipped with parking brakes, pulling out the yellow knob applies both the tractor parking brakes and the trailer service brakes. When the tractor and trailer parking brakes (or trailer service brakes) are both applied, the trailer brakes can be released by pushing in the red knob, leaving the tractor parking brakes applied.

The trailer brake lever (hand control valve) is used for applying the trailer brakes without applying the truck or tractor service brakes. It is usually mounted on the right-hand control panel. See **Fig. 9.3**.

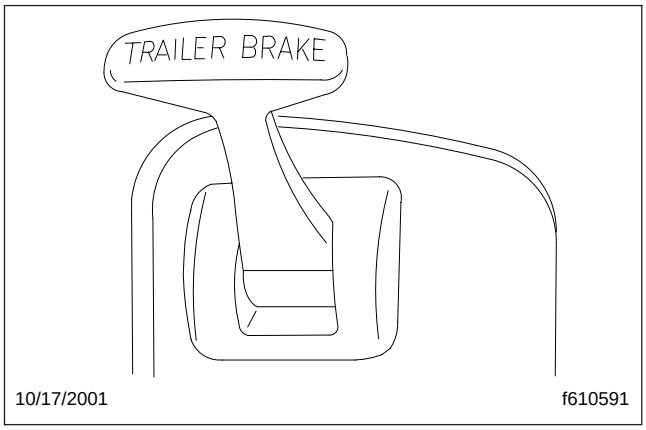

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Fig. 9.3, Trailer Brake Lever

The valve can be partially or fully applied, but in any partially on position it will be overridden by a full application of the service brake pedal. Moving the lever down applies the trailer brakes, while moving it up releases the trailer brakes. The lever will automatically return to the up position when it is released.

On Tractor-Trailers

If both the primary and secondary air systems become inoperative on tractor-trailers, the trailer service brakes or parking brakes will automatically apply when the air pressure drops below 35 to 45 psi (241 to 310 kPa).

The tractor parking brakes will automatically apply when the air pressure drops below 20 to 30 psi (138 to 207 kPa).

On Trucks

Trucks are equipped with spring brake modulation. If an air pressure loss occurs in the primary air system, the rear parking brakes will be modulated (applied and released) in proportion to the service brake application. There will only be enough air in the secondary system for two to four brake applications, at

which time the parking brake control valve will pop out and fully apply the brakes.

On trucks, the parking brakes will apply when the air pressure drops below 20 to 30 psi (138 to 207 kPa). Do not wait for the brakes to apply automatically. Before continuing to operate the vehicle, correct the cause of the air loss.

Automatic Slack Adjusters

Automatic slack adjusters are required on all vehicles equipped with air brakes manufactured after October 20, 1994. Automatic slack adjusters should never be manually adjusted except during routine maintenance of the foundation brakes (e.g., replacing shoes), during slack adjuster installation or in an emergency situation.

When the brake pushrod stroke exceeds the legal brake adjustment limit on a vehicle, there likely is a mechanical problem with the foundation brake components, or the adjuster is improperly installed.

Visit a repair facility as soon as possible when brakes equipped with automatic slack adjusters are determined to be out of adjustment.

⚠ WARNING

Manually adjusting an automatic slack adjuster to bring the pushrod stroke within legal limits is likely masking a mechanical problem. Adjustment is not repairing. In fact, continual adjustment of automatic slack adjusters may result in premature wear of the adjuster itself. Further, the improper adjustment of some automatic slack adjusters may cause internal damage to the adjuster, thereby preventing it from properly functioning.

Air Brake Operation

⚠ WARNING

Do not operate the vehicle with the front brakes backed off or disconnected. Backing off or disconnecting the front brakes will not improve vehicle handling and may lead to loss of vehicle control, resulting in property damage or personal injury.

Before driving the vehicle, secure all loose items in the cab so that they will not fly forward during a full brake application. Make sure all occupants are wearing seat belts.

Parking Brake Interlock

⚠ CAUTION

Do not continually press down on the parking brake control valve (yellow knob) without pressing down on the service brake pedal. This will damage the safety interlock.

The service brakes and parking brakes have a safety interlock that prevents the unintentional release of the parking brake. If the yellow knob is pressed in, it will pop back out unless the service brake pedal is being pressed down.

A decal on the dash alerts you to press down on the service brake pedal before releasing the parking brake. If you do not, the yellow knob will not allow itself to be pressed in, but will return to its old position.

Operating the Brakes

To ensure safe operation and minimum brake wear, do the following steps when operating the brakes.

1. Monitor the air pressure system by observing the low air pressure warning light, the emergency buzzer, and both the primary and secondary air pressure gauges.

   When the ignition switch is turned on, the low air pressure warning light (pressure circle icon) illuminates and the emergency buzzer sounds.

   The warning light and buzzer shut off when air pressure in both systems reaches 65 to 75 psi (448 to 517 kPa).

2. Before driving your vehicle, continue to monitor the air pressure system until the air compressor has built up a minimum pressure of 95 psi (655 kPa) in both the primary and secondary air systems.

3. While driving, the low air pressure warning light and buzzer come on if air pressure drops below 65 to 75 psi (448 to 517 kPa) in either system. If this happens, check the air system pressure gauges to determine which system has low air pressure.

Although vehicle speed can be reduced using the service brake, either the front or rear service brakes will not be operating, causing a longer stopping distance.

Bring the vehicle to a safe stop and have the air system repaired before continuing.

4. During normal brake stops, depress the service brake until braking action slows down the vehicle. Increase or decrease the pressure on the pedal so that the vehicle comes to a smooth, safe stop.

IMPORTANT: In the event of a total loss of service brakes, use the parking brake control valve (yellow knob) to bring the vehicle to a complete stop in the safest location possible.

5. When the forward speed of the vehicle has decreased almost to the idling speed of the engine, press in the clutch pedal (on manual transmissions) and shift the transmission to neutral. Apply the parking brakes, if the vehicle is to be parked.
6. If the brakes are wet, drive the vehicle in low gear and lightly apply the brakes to heat and dry them.

⚠ CAUTION

Do not use the spring parking brakes if the service brakes are hot, such as after descending a steep grade. Also, do not use the spring parking brakes during freezing temperatures if the service brakes are wet. To do so could damage the brakes if hot, or cause them to freeze during cold weather.

If the brakes are wet, drive the vehicle in low gear and lightly apply the brakes to heat and dry them. Allow hot brakes to cool before using the spring parking brakes. Always chock the tires.

7. Allow hot brakes to cool before using the parking brakes. Always chock the tires.

Parking the Vehicle

⚠ WARNING

Do not use the trailer service brakes for parking; they are not designed for this purpose. If air bleeds out of the trailer air tank during parking, the vehicle could roll, causing serious personal injury or property damage.

IMPORTANT: Air pressure in the primary or secondary reservoir must be at least 65 psi (448 kPa) before the tractor parking brakes and the trailer service brakes (or parking brakes) can be released.

On trailers without parking brakes, do the following to park safely:

- To park just the trailer, chock the trailer tires before disconnecting the tractor.
- To park a tractor with a trailer, apply the tractor parking brakes.

Caging the Parking Brakes

⚠ WARNING

Do not drive the vehicle with the parking brakes caged. If the vehicle is driven with the parking brakes caged, there would be no means of stopping the vehicle if a complete loss of air pressure occurred. This could result in serious personal injury or vehicle damage.

To move a vehicle with insufficient system air pressure, it is necessary to release the parking brake springs.

There are two ways to do this:

- Apply an external air source at the gladhands;
- Cage (manually release) the parking brakes.

IMPORTANT: Before caging the parking brakes, make the connection to a towing vehicle or chock the tires.

After correcting the brake system problem, uncage the parking brakes before resuming normal vehicle operation.

Meritor™ WABCO® Antilock Braking System (ABS) for Air Brakes

ABS is an electronic wheel-speed monitoring and control system that works with the air brake system. It passively monitors vehicle wheel speed at all times, but *controls* wheel speed during an emergency or reduced-traction stop. In normal braking

applications, the standard air brake system is in effect.

ABS Operation

The Meritor WABCO ABS is a four-sensor system. It combines one front-axle control channel with one rear-axle control channel to form one control circuit.

Example: The sensor and solenoid control valve at the left front wheel form a control circuit with the sensor and solenoid valve at the right rear wheel.

ABS includes signal-generating tone wheels and sensors located in the wheel hubs of each sensed axle. The sensors transmit vehicle wheel speed information to an electronic control unit.

IMPORTANT: For proper ABS system operation, do not change tire sizes. The sizes of the tires installed during production are programmed into the electronic control unit. Installing different sized tires could result in a reduced braking force, leading to longer stopping distances.

During emergency or reduced-traction stops, fully depress the brake pedal until the vehicle comes to a safe stop. Do *not* pump the brake pedal. With the brake pedal fully depressed, the ABS system will control all wheels to provide steering control and a reduced braking distance.

Although the ABS system improves vehicle control during emergency braking situations, the driver still has the responsibility to change driving styles depending on the existing traffic and road conditions. For example, the ABS system cannot prevent an accident if the driver is speeding or following too close on slippery road surfaces.

The main circuit of the control unit interprets the speed sensor signals and calculates wheel speed, wheel retardation, and a vehicle reference speed. If the calculations indicate wheel lockup, the main circuit signals the appropriate solenoid control valve to reduce braking pressure.

The electronic control unit also has a safety circuit that constantly monitors the wheel sensors, solenoid control valves, and the electrical circuitry. During emergency braking, the solenoid control valve alternately reduces, increases, or maintains the supply of air pressure in the brake chamber, thereby preventing front and/or rear wheel lockup.

Even if the ABS system is partially or completely inoperative, normal braking ability is usually maintained.

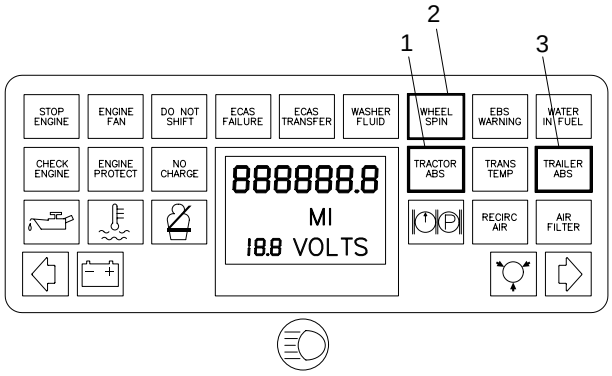
IMPORTANT: If a solenoid control valve (or combination solenoid control valve) is damaged and inoperative, normal braking may be impaired.

ABS Indicator Lights

IMPORTANT: If any of the ABS indicator lights do not work as described below, or come on while driving, repair the ABS system immediately to ensure full antilock braking capability.

Tractor ABS Light

If equipped only with the tractor ABS system, the amber TRACTOR ABS indicator light (see **Fig. 9.4**) comes on after the ignition switch is turning on. The indicator light goes out only if all of the tractor ABS components are working.



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1. Tractor ABS Indicator
2. Wheel Spin Indicator (optional)
3. Trailer ABS Indicator

Fig. 9.4, ABS Indicator Lights

CAUTION

An accumulation of road salt, dirt, or debris on the ABS tone wheels and sensors can cause the ABS warning light to come on. If the ABS light does come on, the tone rings and sensors should be inspected for corrosion and serviced if necessary. The service should include cleaning

of the tone rings and sensors. If any tone ring on a vehicle shows severe corrosion, all tone rings on that vehicle should be replaced.

During winter months in areas where corrosive materials are used on the highways, periodically clean the underside of the vehicle, including the tone rings and sensors, to ensure proper ABS function and to protect the components from corrosion. Clean more frequently when unusually corrosive chemicals are being used.

During vehicle operation, if the safety circuit senses a failure in any part of the ABS system (a sensor, solenoid control valve, wiring connection, short circuit, etc.), the TRACTOR ABS indicator light comes on and the control circuit where the failure occurred is switched to normal braking action. The remaining control circuit will retain the ABS effect.

Trailer ABS Light

The amber TRAILER ABS indicator light operates as follows when a compatible trailer is properly connected to the tractor:

- When the ignition switch is turned to the on position, the trailer ABS light will illuminate momentarily, then turn off.
- If the light comes on momentarily during vehicle operation, then shuts off, a fault was detected and cleared.
- If the light flickers, or comes on and goes off repeatedly, it could indicate an intermittent wiring problem. Bring the vehicle to an authorized Freightliner service facility for testing and repairs.
- If the light comes on and stays on during vehicle operation, there is a fault with the trailer ABS. Repair the trailer ABS system immediately to ensure full antilock braking capability.

The Trailer ABS light will not illuminate unless a compatible trailer is connected to the tractor.

IMPORTANT: If a compatible trailer is connected, and the light is not illuminating for three seconds when the ignition switch is turned to the ON position, it is possible that the light is burnt out.

Wheel Spin Light

If equipped with Automatic Traction Control (ATC), the amber WHEEL SPIN indicator light illuminates if one of the drive wheels spins during acceleration. When the light illuminates, partially release the throttle pedal until the light goes out. The light goes out when the wheel stops spinning.

If slippery road conditions continue, turn on the differential lock switch (on dual-drive vehicles, turn on the interaxle lock switch). See **Chapter 8** for axle switch instructions.

⚠ CAUTION

Do not turn the differential lock switch on while the WHEEL SPIN indicator light is on. To do so could damage the rear axle.

Automatic Traction Control, Optional

Automatic Traction Control is an option available on ABS-equipped vehicles with air brake systems. It improves traction when vehicles are on slippery surfaces by reducing drive wheel overspin. ATC works automatically in two ways.

- If a drive wheel starts to spin, ATC applies air pressure to brake the wheel. This transfers engine torque to the wheels with better traction.
- If all drive wheels spin, ATC reduces engine torque to provide improved traction.

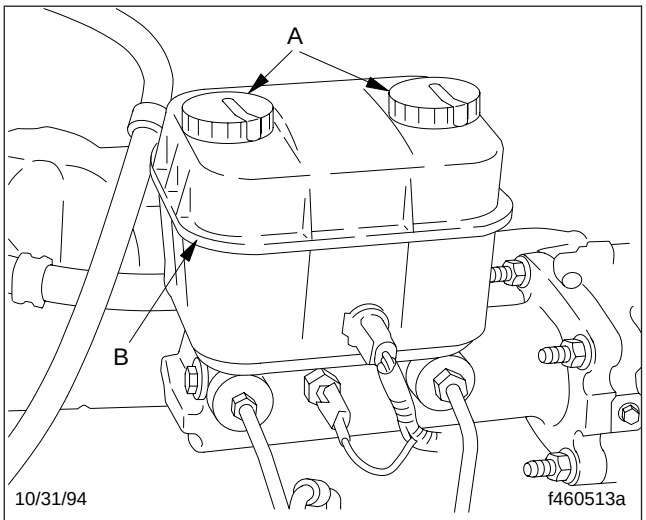
ATC turns itself on and off. Drivers do not have to select this feature. If drive wheels spin during acceleration, the WHEEL SPIN indicator comes on, indicating ATC is active. It goes out when the drive wheels stop spinning.

Hydraulic Brake System

General Information

The hydraulic brake system includes a power booster, master cylinder, reservoir, hydraulic lines, a brake rotor on each wheel hub, and a brake caliper and pad assembly at each rotor.

IMPORTANT: Make sure that the fluid level in the master cylinder reservoir is up to the ridge that surrounds the reservoir. See **Fig. 9.5**. Use only heavy-duty brake fluid, DOT 3, in the hydraulic brake system.



A. Open caps and check fluid level.
B. Fill to this level.

Fig. 9.5, Hydraulic Brake Reservoir

The master cylinder controls braking power to the front and rear brakes. The Bendix Hydro-Max® power booster is attached to the rear of the master cylinder and is connected to the power steering system (which provides pressurized power steering fluid). An electrically powered backup pump operates if there is inadequate fluid flow from the power steering pump to the power booster. The brake system warning light comes on if there is a problem within the system. Bring the vehicle to a safe stop and correct the problem before continuing operation of the vehicle. See **Group 42** of the *Business Class® M2 Workshop Manual* for hydraulic brake system troubleshooting and adjustment procedures.

Operation

Before driving the vehicle, secure all loose items in the cab so that they will not fly forward during a full brake application. Make sure that all occupants are wearing seat belts. Check that the brake system warning light is off after releasing the parking brake. If the warning light does not go off, correct the problem before continuing operation of the vehicle.

During normal brake stops, depress the foot brake control pedal until braking action slows down the vehicle. Increase or decrease the pressure on the pedal so that the vehicle comes to a smooth, safe stop. When the forward speed of the vehicle has decreased to almost the idling speed of the engine, push the clutch pedal in, and shift the transmission into Neutral. Apply the parking brake if the vehicle is to be parked.

Meritor™ WABCO® Antilock Braking System (ABS) for Hydraulic Brakes

The Meritor WABCO Antilock Braking System (ABS) is an electronic wheel-speed monitoring and control system that works with the hydraulic brake system. ABS passively monitors vehicle wheel speed at all times, but *controls* wheel speed during an emergency or reduced-traction stop. In normal braking applications, the standard hydraulic brake system is in effect.

IMPORTANT: For proper hydraulic ABS operation, Meritor WABCO recommends that front and rear tire sizes be within 16% of each other. Contact the Meritor WABCO Customer Support Center at 800-535-5560 if you plan a tire size difference greater than ±8%. Installing different sized tires could result in inaccurate wheel speed signals to the ECU resulting in a reduced braking force, which could lead to longer stopping distances.

ABS includes signal-generating tone rings and sensors located in the wheel hubs of each sensed axle. The sensors transmit vehicle wheel speed information to the ECU which interprets these signals to calculate wheel speed and a vehicle reference speed. If the calculations indicate wheel lockup, the appropriate control circuit signals the brake pressure modulator to increase or decrease braking pressure.

⚠ CAUTION

An accumulation of road salt, dirt, or debris on the ABS tone wheels and sensors can cause the ABS warning light to come on. If the ABS light does come on, the tone rings and sensors should be inspected for corrosion and serviced if necessary. The service should include cleaning of the tone rings and sensors. If any tone ring on a vehicle shows severe corrosion, all tone rings on that vehicle should be replaced.

During winter months in areas where corrosive materials are used on the highways, periodically clean the underside of the vehicle, including the tone rings and sensors, to ensure proper ABS

function and to protect the components from corrosion. Clean more frequently when unusually corrosive chemicals are being used.

The ECU also has a safety circuit that constantly monitors the wheel sensors, brake pressure modulator, and the electrical circuitry. The ABS indicator lamp comes on after the ignition is switched on and will go out within three seconds if the system is functioning correctly. If the ABS indicator lamp does not come on, or does not go out after three seconds, have the vehicle serviced before operation.

If, during vehicle operation, the safety circuit senses a failure in any part of the ABS system (a sensor, brake pressure modulator, wiring connection, short circuit, etc.), the warning lamp comes on and the control circuit where the failure occurred is switched to normal braking action. Even if the ABS system is partially or completely inoperative, normal braking ability is maintained. An exception would be if the brake pressure modulator or a hydraulic fluid line is damaged. Since these components are an integral part of the hydraulic brake system, normal braking may be impaired or inoperative.

IMPORTANT: If any of the ABS warning lights do not work as described above, or come on while driving, repair the ABS system immediately to ensure full antilock braking capability.

During emergency or reduced-traction stops, fully depress the brake pedal until the vehicle comes to a safe stop; *do not pump* the brake pedal. With the brake pedal fully depressed, the ABS system will control all wheels to provide steering control and a reduced braking distance.

Although the ABS system improves vehicle control during emergency braking situations, the driver still has the responsibility to change driving styles depending on the existing traffic and road conditions. For example, the ABS system cannot prevent an accident if the driver is speeding or following too close on slippery road surfaces.

10

Fifth Wheels and Trailer Couplings

Fifth Wheels, General Information 10.1
Fifth Wheel Coupling 10.1
Fifth Wheel Uncoupling 10.4
Fifth Wheel Slide 10.7

Fifth Wheels, General Information

WARNING

Do not use any fifth wheel that fails to operate properly. Doing so may cause loss of vehicle control, possibly resulting in severe personal injury or death.

Air-Suspension Dump Valve

The air-suspension dump valve may be used to adjust the tractor height to aid with coupling to or uncoupling from a trailer. See **Fig. 10.1**. When the switch is set to LOWER, the air-suspension dump valve deflates the air springs to lower the rear of the vehicle. In the AUTO position, the automatic ride-control valves operate for normal driving.

WARNING

Never exhaust air from the suspension while driving. The suspension will not absorb road shocks, possibly damaging components, and vehicle handling may be compromised. This could result in loss of vehicle control, possibly resulting in severe personal injury or death.

NOTICE

Do not operate the vehicle over uneven ground such as ramps, speed bumps, curbs, etc. with the air springs deflated. Doing this may lead to air bag separation from the piston, preventing the suspension air springs from inflating.

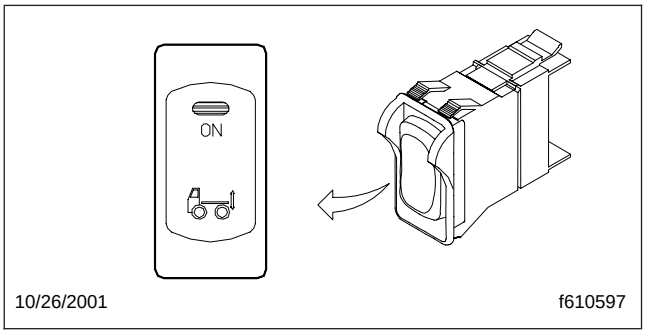


Fig. 10.1, Air-Suspension Dump Valve

Fifth Wheel Lubrication

WARNING

Keep the fifth wheel plate lubricated to prevent binding between the tractor and trailer. A binding fifth wheel could cause erratic steering and loss of vehicle control, possibly resulting in personal injury or death.

The standard fifth wheel plate must be kept well lubricated with chassis grease to prevent friction and binding between the tractor fifth wheel plate and the trailer.

For a low-lube fifth wheel plate, inspect the condition of the low-lube pads. There should be no damaged or missing pieces. Slight puckering at the outside edges is normal.

For lubrication instructions, see **Group 31** of the *Business Class M2 Maintenance Manual*.

Fifth Wheel Coupling

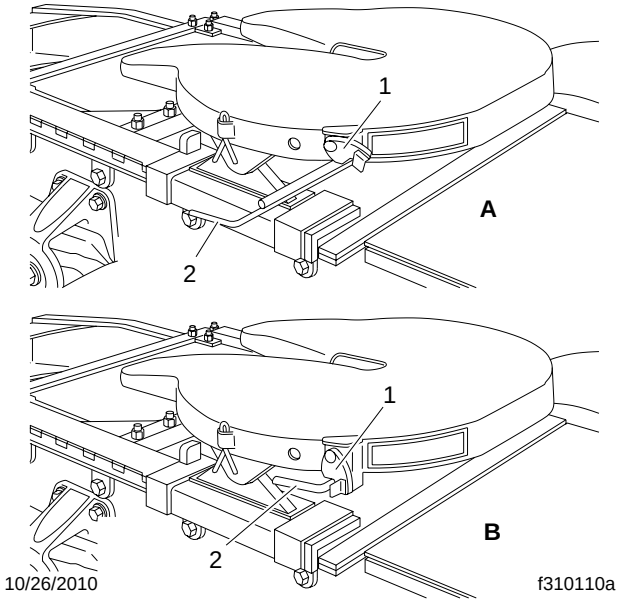
Fifth wheel coupling is activated with the lock control handle located on either the right side or left side of the fifth wheel. Coupling has successfully occurred when the kingpin has been forced into the jaws and the lock control handle has moved to the locked position.

NOTICE

Some fifth wheels may be mounted on sliding rails. Before attempting to couple a trailer to a sliding fifth wheel, the slide feature must be locked to prevent the top plate from sliding rapidly forward or rearward, causing damage to the fifth wheel or kingpin.

Fontaine and Holland Fifth Wheels Coupling

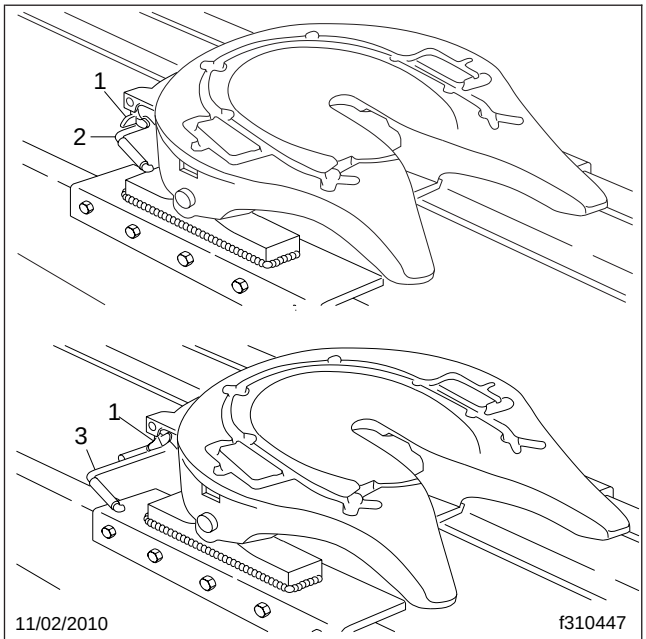
1. Chock the front and rear of the trailer tires to prevent the trailer from moving.
2. Ensure the fifth wheel jaw is fully open and the operating rod is in the unlocked position. See **Fig. 10.2** or **Fig. 10.3**.
3. Make sure the fifth wheel top plate is tilted so the ramps are as low as possible.



NOTE: Make sure the safety latch is down when the control handle is locked.

A. Unlocked
B. Locked
1. Safety Latch
2. Lock Control Handle

Fig. 10.2, Fontaine Locking Mechanism



1. Safety Latch
2. Operating Rod (locked)
3. Operating Rod (unlocked)

Fig. 10.3, Holland Simplex SE Locking Mechanism

4. Position the tractor so that the center of the fifth wheel is in line with the trailer kingpin. The kingpin should be in a position to enter the throat of the locking mechanism.

NOTICE

Attempting to couple at the wrong height may cause improper coupling, which could result in damage to the fifth wheel or kingpin.

5. Adjust the trailer height if required.

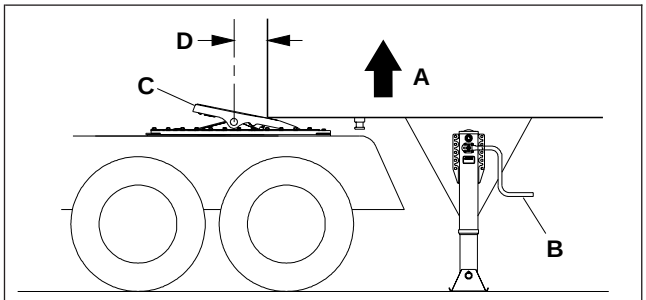
   For a standard fifth wheel plate, the trailer should contact the fifth wheel approximately 4 to 8 inches (10 to 20 cm) behind the fifth wheel pivot. See **Fig. 10.4**.

   For a low-lube fifth wheel plate, the fifth wheel must slide freely under the trailer, and the trailer should contact the fifth wheel at the pivot. See **Fig. 10.5**.

6. With the fifth wheel lock opening aligned with the trailer kingpin, back the tractor slowly toward the trailer. After sliding under the trailer, STOP to prevent from hitting the kingpin too hard, then resume backing slowly until the fifth wheel locks.

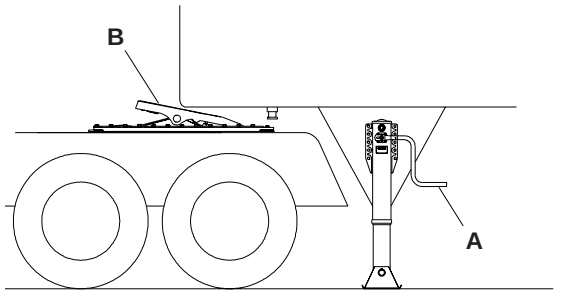
   On a standard fifth wheel, the fifth wheel must lift the trailer.

   On a low-lube fifth wheel, do not lift the trailer as this may damage the fifth wheel plate.



A. Fifth wheel must lift trailer
B. Adjust trailer height
C. Ramps tilted down
D. 4 to 8 inches

Fig. 10.4, Trailer Connection Point, Standard Fifth Wheel



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A. Adjust trailer height B. Ramps tilted down

Fig. 10.5, Trailer Connection Point, Low-Lube Fifth Wheel

7. Apply the tractor parking brakes.

WARNING

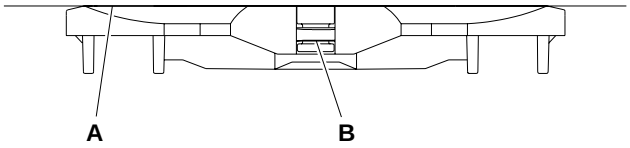
A visual inspection is required by law. Some improper couplings can pass a pull test. Sound is not reliable. Get out of the cab and look. Incorrect coupling could cause the trailer to disconnect, possibly resulting in serious personal injury or death.

8. Perform a coupling inspection, checking that there is no gap between the bottom of the trailer and the fifth wheel, and that the kingpin is securely locked. See **Fig. 10.6**

   When lockup has occurred, the fifth wheel control handle moves to the locked position. Make sure that the safety latch is down over the lock control handle to hold the control handle in the locked position. (The safety latch will only rotate down if the operating rod is fully retracted in the locked position.) See **Fig. 10.2** for Fontaine fifth wheels. See **Fig. 10.3** for Holland fifth wheels.

9. Release the tractor parking brakes. Test for kingpin lockup slowly inching the tractor forward, pulling on the trailer against the chocks.

10. After lockup is completed, connect the tractor-to-trailer air system lines and the electrical cable to the trailer. Take care to prevent dirt or foreign material from entering the air system lines.



09/10/2010 f311126

A. No gap between trailer and fifth wheel B. Kingpin inside lock

Fig. 10.6, Coupling Inspection

NOTICE

Always make sure the connection hanger keeps the trailer air hoses and electrical cables positioned so that they do not rub on anything. Rubbing may wear through hoses or cables, resulting in air leaks, or exposed or broken wires, potentially affecting trailer brake or electrical systems.

11. Charge the air brake system with air, checking that the air connections do not leak.

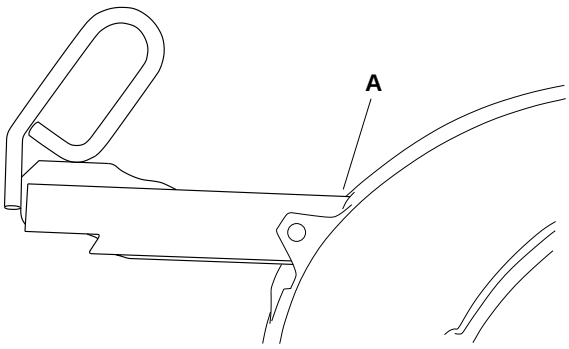
WARNING

Incorrect fifth wheel lock adjustment could cause the trailer to disconnect, possibly resulting in serious personal injury or death.

12. With the trailer wheels chocked and the brakes set, check for clearance between the kingpin and the fifth wheel jaws by moving the tractor forward and backward against the locked kingpin. If slack is present, uncouple the trailer and have the fifth wheel inspected and adjusted by a certified technician.

Jost Fifth Wheel Coupling

1. Tilt the ramp down.
2. Open the kingpin locks. See **Fig. 10.7**.
3. Back the vehicle close to the trailer, centering the kingpin on the fifth wheel.
4. Chock the trailer wheels.
5. Connect the air lines and electrical cable.
6. Ensure that the red trailer air supply valve (trailer brake) is pulled out, and that the trailer parking



A. Lock held open by catch mechanism

Fig. 10.7, Jost Release Handle Unlocked

brakes are set. See **Chapter 5** in this manual for operation of the dash-mounted brake controls.

NOTICE

Attempting to couple at the wrong height may cause improper coupling, which could result in damage to the fifth wheel or kingpin.

7. Adjust the trailer height (if required).

   For a standard fifth wheel plate, the trailer should contact the fifth wheel approximately 4 to 8 inches (10 to 20 cm) behind the pivot. See **Fig. 10.4**.

   For a low-lube fifth wheel plate, the fifth wheel must slide freely under the trailer, and the trailer should contact the fifth wheel at the pivot. See **Fig. 10.5**.

8. Back the tractor under the trailer.

   On a standard fifth wheel, the fifth wheel must lift the trailer.

   On a low-lube fifth wheel, do not lift the trailer as this may damage the fifth wheel plate.

9. After sliding under the trailer, STOP to prevent from hitting the kingpin too hard, then resume backing slowly until the fifth wheel locks.

⚠ WARNING

A visual inspection is required by law. Some improper couplings can pass a pull test. Sound is not reliable. Get out of the cab and look. Incorrect coupling could cause the trailer to disconnect, possibly resulting in serious personal injury or death.

10. Apply the tractor parking brake, then perform a physical check for positive kingpin lockup, and that there is no gap between the trailer and the fifth wheel. See **Fig. 10.6**.

11. Ensure that the release handle is in the locked position adjacent to the casting. See **Fig. 10.8**.

12. Release the tractor parking brakes and test for kingpin lockup by slowly moving the tractor forward, pulling on the trailer against the chocks.

Fifth Wheel Uncoupling

Manual Uncoupling

1. Apply the tractor and trailer parking brakes.
2. Chock the trailer rear wheels.
3. Lower the trailer landing gear until the weight is removed from the fifth wheel.
4. Disconnect the tractor-to-trailer air system lines and electrical cable. Plug the air lines to prevent dirt or foreign material from entering the lines.
5. Verify that both the yellow parking-brake and red trailer-air-supply knobs are out, the tractor and trailer parking brakes are set, and that the trailer is prepared for uncoupling.
6. Release the kingpin locking mechanism following the instructions for each manufacturer below.

   6.1 **Fontaine:** Lift the safety latch and pull the lock control handle to the unlocked position.

   6.2 **Holland:** In the locked position the safety indicator swings freely over the operating rod. See **Fig. 10.9**, View A.

   To unlock the mechanism, manually rotate the safety indicator toward the rear of the fifth wheel. See **Fig. 10.9**, View B.

   Pull the operating rod out. When the upper operating rod shoulder is outside the slot, raise the handle and place the shoulder of the upper rod against the plate casting, above the slot. See **Fig. 10.9**, View C.

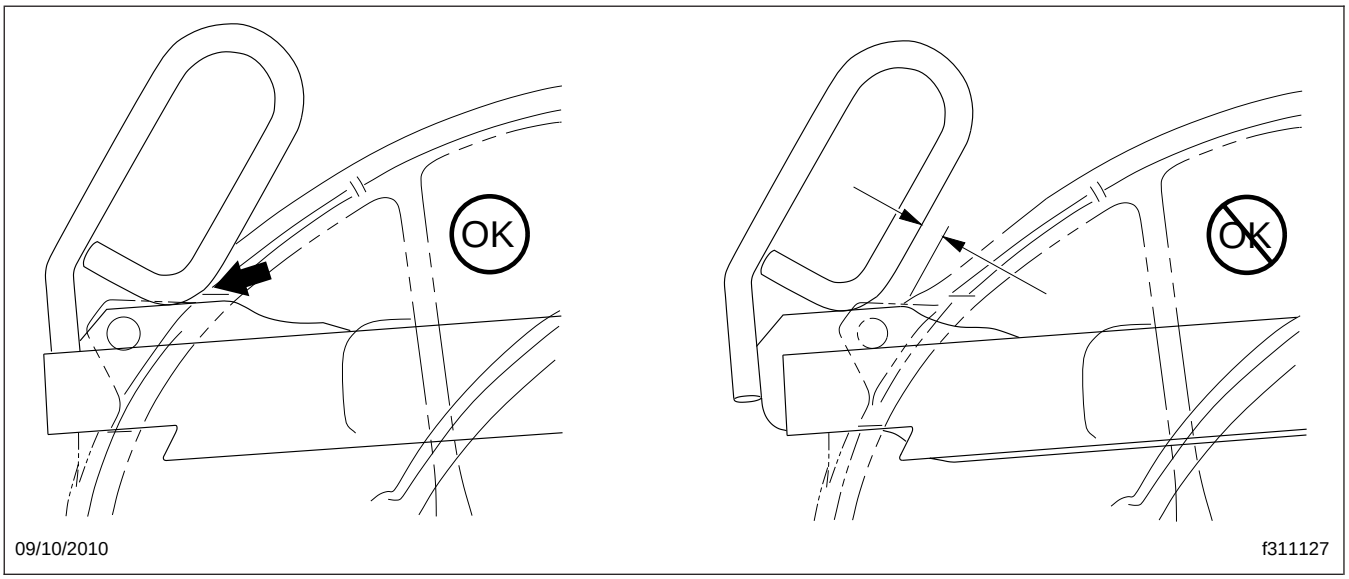


Fig. 10.8, Jost Release Handle Locked

The fifth wheel is now in the lockset position and is ready for uncoupling. As the tractor pulls away from the trailer the kingpin forces the jaw to rotate, contacting the lock. Continued rotation of the jaw forces the lock to move outward, and drops the upper rod back into the slot. See **Fig. 10.9** View D. The wheel is now ready for coupling.

6.3 **Jost:** Pull the retractable handle out, then secure it in the open position with the catch.

7. Release the tractor parking brake then drive out slowly, allowing the trailer to slide down the fifth wheel and pick-up ramps.

Air-Actuated Uncoupling

An air-actuated kingpin release valve is optional with all fifth wheels. See **Fig. 10.10**.

NOTE: In the event of an air system failure, air-actuated kingpins can be manually released following the instructions for manual unlocking.

⚠ WARNING

Once the kingpin release valve has been pulled the kingpin lock is released. The vehicle MUST NOT be driven with the trailer until the trailer has been uncoupled and coupled again. Failure to do so may result in separation of the trailer from the tractor, possibly causing serious personal injury or death.

Preparing the Trailer for Uncoupling

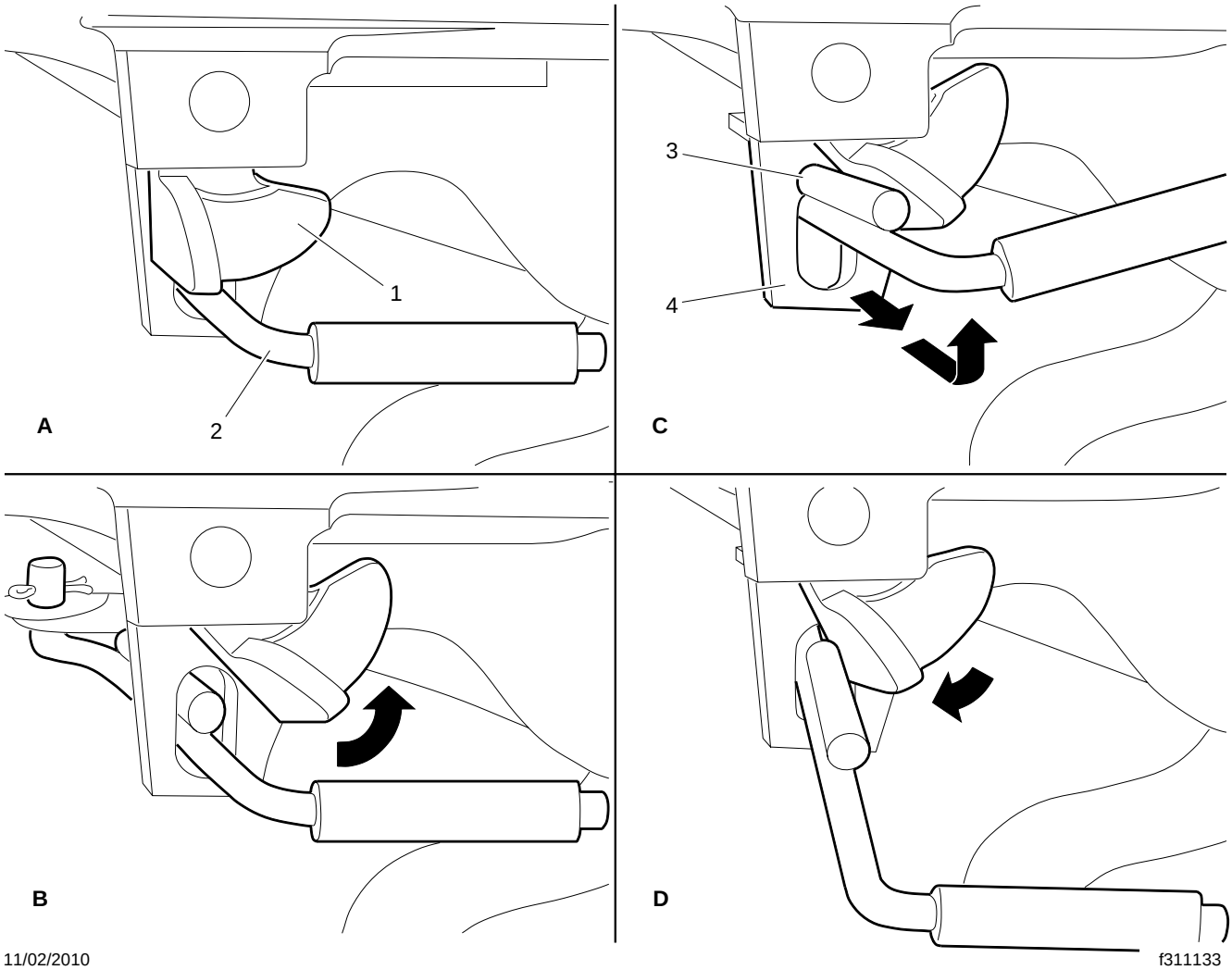
Before using the air valve to unlock a fifth wheel kingpin, prepare the trailer as follows.

1. Apply the tractor and trailer parking brakes.
2. Chock the trailer rear wheels.
3. Lower the trailer landing gear until the weight is removed from the fifth wheel.
4. Disconnect the tractor-to-trailer air lines and electrical cable. Plug the air lines to prevent dirt or foreign material from entering the lines.

Fontaine and Holland Fifth Wheels Air-Activated Kingpin Unlock

1. Verify that both the yellow parking-brake and red trailer-air supply knobs are out, the tractor and trailer parking brakes are set, and that the trailer is prepared for uncoupling.

NOTE: On Fontaine and Holland fifth wheels, if the tractor parking brake is not set, the air-actuated kingpin-release valve will not activate.



A. Locked Position
B. Unlatched Position (safety indicator rotated towards the rear of the fifth wheel)
1. Safety Indicator
2. Operating Rod
C. Lockset Position (upper rod resting against casting above slot)
D. Open Position (ready for recoupling)
3. Upper Rod
4. Plate Casting

Fig. 10.9, Holland Kingpin Locking Mechanism

2. Pull and hold the kingpin release valve until the kingpin lock mechanism opens and locks in place. See **Fig. 10.10**.
3. Release the pull valve.
4. Release the tractor parking brake.
5. Drive out from under the trailer.

Jost Fifth Wheels Air-Activated Kingpin Unlock

1. Verify that both the yellow parking-brake and red trailer-air-supply knobs are out, the tractor and trailer parking brakes are set, and that the trailer is prepared for uncoupling.

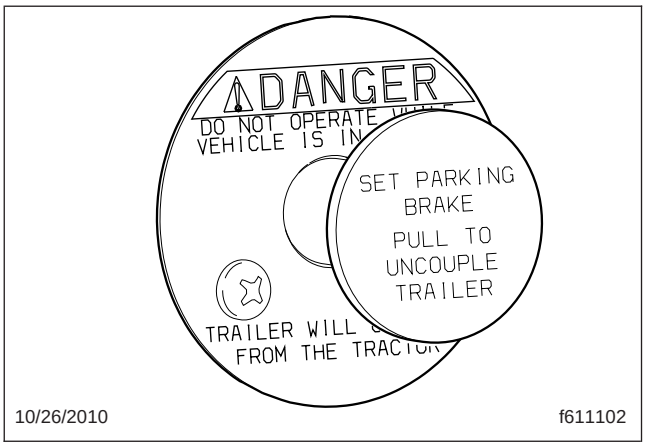


Fig. 10.10, Air-Actuated Kingpin Release Valve

NOTE: With Jost fifth wheels, if the trailer parking brake is not set the air-actuated valve will not activate.

2. Release the tractor parking brake.
3. Pull and hold the kingpin release valve, then drive forward slowly.
4. After the trailer has slid down the fifth wheel and pick-up ramps, release the pull valve.

Fifth Wheel Slide

⚠ WARNING

Adjust the fifth wheel slide correctly, and do not overload any tractor axle by incorrectly loading the trailer. Incorrect slide adjustment or improper axle loading could cause erratic steering and loss of vehicle control, possibly resulting in serious personal injury or death.

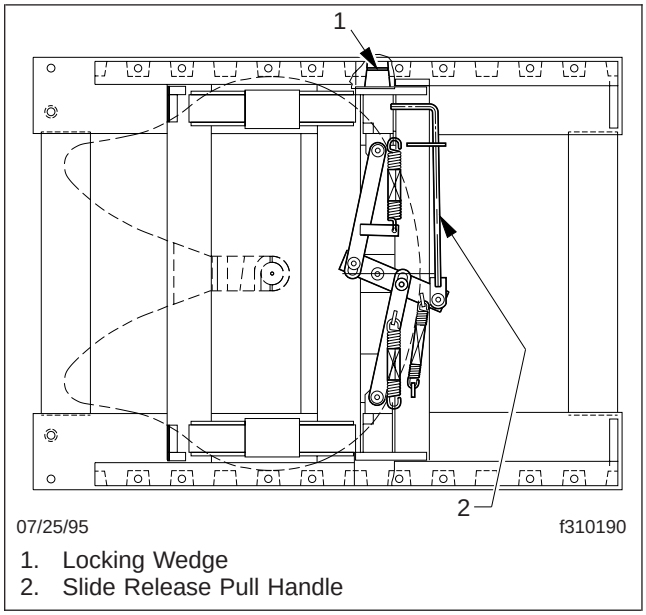
On sliding fifth wheel assemblies, the fifth-wheel plate is attached to rails that allow forward and rearward movement of the fifth wheel to optimally distribute the load across the axles. Slots are evenly spaced along the slide rails, and retractable wedges are positioned through the slots to hold the fifth wheel in the desired position.

The amount of load distribution on the front steering axle and rear drive axle(s) will have a direct effect on the steering control of the vehicle. Determine the front and rear axle weights by weighing the vehicle on scales designed for this purpose.

The maximum axle weight ratings are shown on the Federal Motor Vehicle Safety Standard (FMVSS) label or Canadian Motor Vehicle Safety Standard (CMVSS) label attached to the left rear door post of the tractor. The desired load on the axle is no less than 80 percent of the maximum axle weight rating, but in no instances should the axle load exceed the maximum axle weight rating given on the FMVSS or CMVSS label.

Manual Slide Operation

The manual slide feature is operated from the fifth wheel plate with a manual release handle using the following procedure. See **Fig. 10.11**.



1. Locking Wedge
2. Slide Release Pull Handle

Fig. 10.11, Manual Release Sliding Fifth Wheel (Fontaine shown)

1. Stop the tractor and trailer in a straight line on level ground. Pull the red trailer air supply knob to apply the trailer parking brakes.
2. Apply the tractor parking brake, then release the sliding mechanism using the appropriate method for the fifth wheel manufacturer.

   2.1 **Fontaine:** Lift the slide release pull handle to disengage it from the guide plate. Then, pull out the handle until it is in the unlocked position and can be positioned against the guide plate to hold it out. The

handle will stay in the unlocked position until it is manually disengaged from the guide plate. See **Fig. 10.12**.

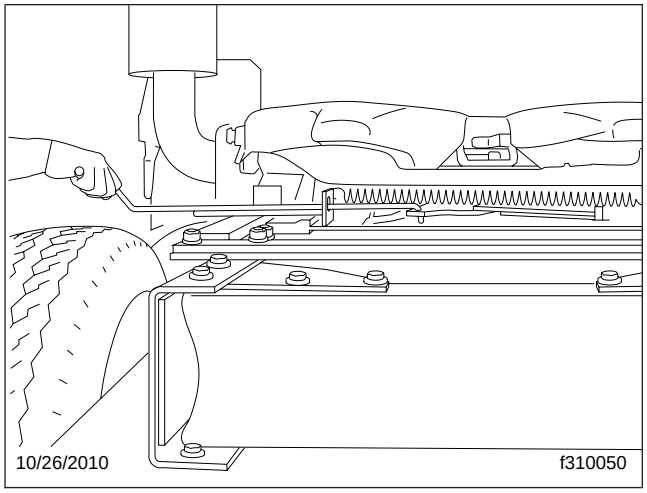
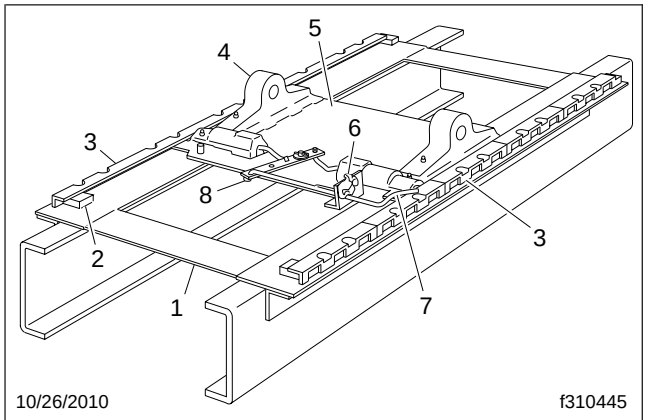


Fig. 10.12, Releasing the Sliding Fifth Wheel, (Fontaine)

2.2 **Holland:** Pull the operating rod out. Make sure both side plungers have released. See **Fig. 10.13**.



1. Baseplate
2. Bolted Stop
3. Baseplate Rail
4. Fifth Wheel Mount
5. Slider Saddle Plate
6. Safety Latch
7. Operating Rod
8. Operating Lever

Fig. 10.13, Sliding Fifth Wheel Manual Release, (Holland Simplex)

3. Lower the trailer landing gear just enough to remove the weight from the tractor.
4. Chock the front and rear of the trailer tires to prevent the trailer from moving.
5. Release the tractor parking brakes, then slowly move the tractor forward or backward until the fifth wheel is in the desired location.

NOTICE

When moving the fifth wheel to the desired position, be sure the trailer landing gear will not at any time come in contact with the tractor frame or other components. Make sure that the front of the trailer will not come in contact with the rear of the cab or with other components if they extend beyond the rear of the cab.

⚠ WARNING

Check that the locking wedges have seated in the slots. Failure to achieve complete lockup may allow disengagement of the tractor from the trailer, possibly resulting in serious personal injury or death.

6. Apply the tractor parking brakes, then lock the sliding member in position using one of the following methods:

   6.1 **Fontaine:** Disengage the slide release pull handle from the guide plate. The slide release pull handle is spring-loaded in the locked position and will seek the locked position when disengaged from the guide plate. After the slide release pull handle returns to the fully locked position, visually and physically check the locking wedges to make sure they are fully inserted into the slots in the slide rails. Make sure the handle is locked in position against the guide plate.

   6.2 **Holland:** Raise the operating rod so that it is free to move inward. Make sure that the lock pins have seated in the base plate rail holes and the operating rod moves into the locked position.

NOTE: The fifth wheel may need to be moved slightly to enable the locking wedges to enter the fully locked position.

Air Slide Operation

The slide feature may be operated with an air switch mounted in the dash, that operates an air cylinder that locks and unlocks the slide. See **Fig. 10.14**.

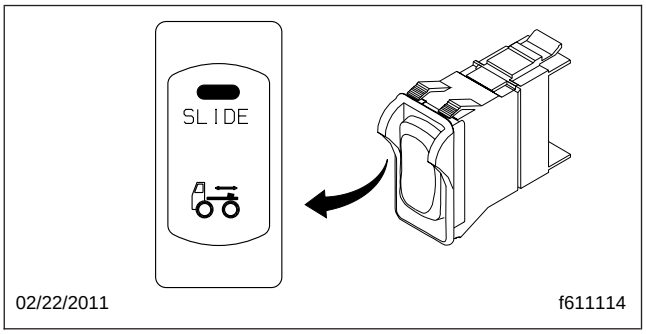


Fig. 10.14, Air-Slide Switch

1. Set the air-slide switch to UNLOCK. See **Fig. 10.14**

   Ensure the locking plungers have released. See **Fig. 10.15**.

   For Jost fifth wheels, the mechanism activates as shown in **Fig. 10.16**.

2. Lower the trailer landing gear just enough to remove the weight from the tractor.

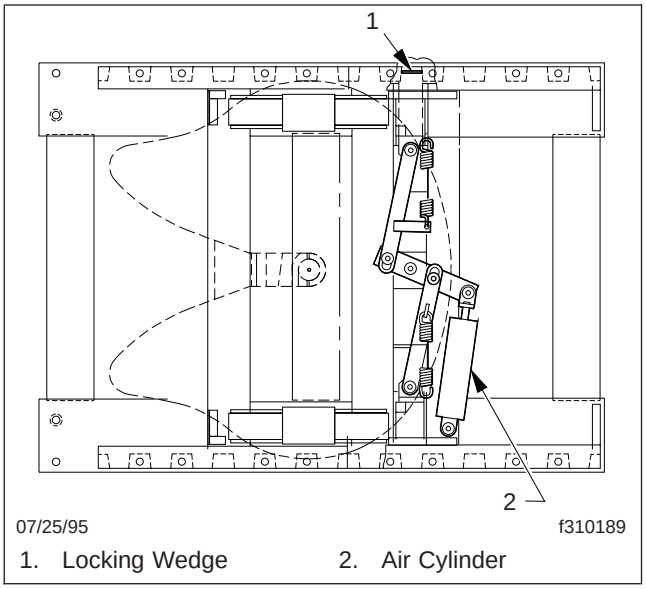


Fig. 10.15, Air-Operated Sliding Fifth Wheel (Fontaine shown)

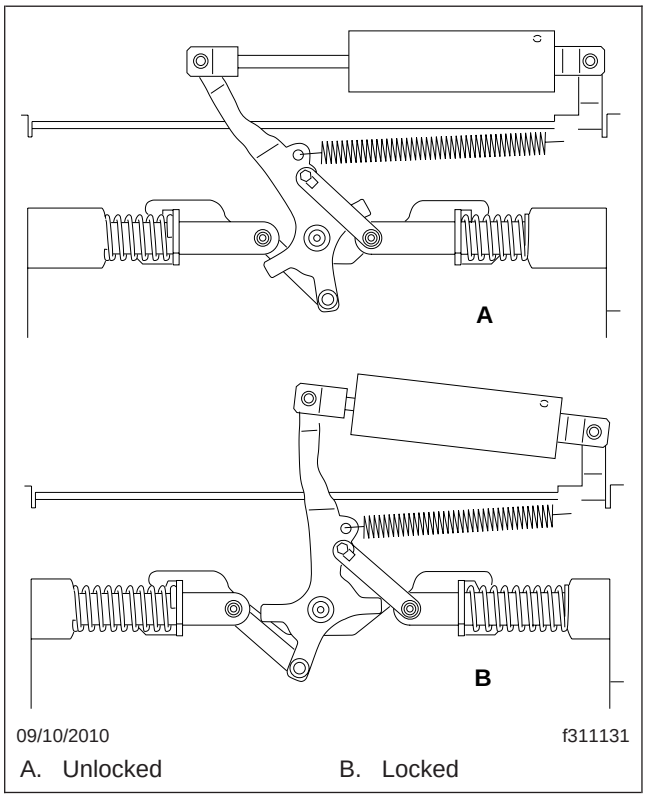


Fig. 10.16, Jost Sliding Fifth Wheel

3. Pull the red trailer-air-supply knob to set the trailer-parking brakes.
4. Slowly move the tractor forward or backward until the fifth wheel is in the desired location.

NOTICE

Ensure the trailer landing gear does not come in contact with the tractor frame or other components, and that the front of the trailer will not come in contact with the rear of the cab or other components if they extend beyond the rear of the cab.

5. Apply the tractor parking brakes.

⚠ WARNING

Check that the locking wedges have seated in the slots. Failure to achieve complete lockup may allow disengagement of the tractor from the

trailer, possibly resulting in serious personal injury or death.

6. Set the air-slide switch to LOCK. Visually inspect the locking wedges or plungers to make sure that they are fully inserted in the slide rail slots. Verify that the plungers have engaged by tugging the tractor forward while the trailer brakes are locked and the wheels are chocked.

NOTE: The fifth wheel may need to be moved slightly to enable the locking wedges to fully lock.

11

Pretrip and Post-Trip Inspections and Maintenance

Pretrip and Post-Trip Inspection Checklists 11.1
Pretrip and Post-Trip Maintenance Procedures 11.3

Pretrip and Post-Trip Inspection Checklists

Regulations in both Canada and the United States clearly indicate that it is the driver's responsibility to perform an inspection and ensure the complete roadworthiness of a vehicle before placing it into service for the day. Commercial vehicles may be subject to inspection by authorized inspectors, and an unsafe vehicle can be put "out of service" until the driver or owner repairs it.

IMPORTANT: The pre- and post-trip checklists, and inspections and maintenance procedures detailed in this chapter, are **not all-inclusive**. Also refer to other component and body manufacturers' instructions for specific inspection and maintenance instructions.

Use the inspection checklists to ensure that vehicle components are in good working condition before each trip. A driver that is familiar with the vehicle, and drives it regularly, can perform the daily inspections, then add the weekly and monthly post-trip inspections as scheduled. If the driver does not operate the vehicle on a consistant basis, all three of the inspection procedures should be performed before the trip.

NOTE: Procedure reference numbers in the checklists reference the corresponding detailed instructions found under the pretrip and post-trip maintenance procedures.

Pre- and post-trip inspections cannot be done quickly. However, careful inspections save time by eliminating stops later to adjust items overlooked or forgotten.

If any system or component does not pass this inspection, it must be corrected before operating the vehicle. Whenever equipment requires adjustment, replacement, repair, addition of lubricants, or a change of lubricants, see the *Business Class® M2 Workshop Manual* for procedures and specifications, and see the *Business Class® M2 Maintenance Manual* for lubricant recommendations, specifications, and maintenance intervals.

See **Table 11.1** for a list of procedures that should be perfomed daily, before the first trip.

See **Table 11.2** for a list of procedures that should be performed weekly, post-trip.

See **Table 11.3** for a list of procedures that should be performed monthly, post-trip.

IMPORTANT: Before performing any checks, apply the parking brake and chock the tires.

Procedure Performed (check off)	Daily Pretrip Inspections/Checks	Procedure Reference
_____	Drain manually drained air reservoirs (not equipped with automatic drain valves)	D1
Check _____	windshield washer reservoir fluid	D2
Check _____	surge tank coolant; and, if equipped, coolant for hybrid cooling system	D3
Inspect _____	radiator and charge air cooler	D4
Check _____	engine for fuel, oil, or coolant leaks	—
Inspect _____	engine and chassis wiring	D5
Inspect _____	air intake system	D6
Check _____	intake-air restriction indicator mounted on air intake	D6
Check _____	engine oil level	D7
Check _____	power steering fluid level	—
Inspect _____	fuel tank(s), fuel lines, connections, and fuel level	D8
Check _____	fuel/water separator	D9
Inspect _____	natural gas fuel system, if equipped	D10
Inspect _____	front and rear suspension components	D11
Inspect _____	headlights, mirrors, and window glass, and windshield wipers	D12
Check _____	doors (open without difficulty and close securely)	—
_____	Adjust driver's seat, then align rearview and downview mirrors	—
Check _____	dash-mounted intake-air restriction indicator	D6
Check _____	oil- and air-pressure warning systems	D13
Check _____	ICU fault codes	D14
Check _____	horn, windshield wipers, and windshield washer	D15
Check _____	heater, defroster, and optional mirror heat controls	D16
Check _____	backup alarm	—
Check _____	panel lights and interior lights	D17
Check _____	exterior lights and reflectors	D18
Check _____	tire pressure	D19
Inspect _____	tire condition	D20
Inspect _____	rims and wheels	D21
Inspect _____	hub oil seals and lubrication levels	D22
Check _____	automatic transmission fluid level	—
Inspect _____	air brake chambers and pushrods	D23
Inspect _____	air brake lines	D24
Inspect _____	slack adjusters	D25
Check _____	air brake system operation	D26
Check _____	Bendix Hydro-Max® Power Booster, if equipped	D27
Inspect _____	frame rails (missing bolts) and crossmembers (bent or loose)	—
Check _____	mud flaps (aren't damaged, at least 10 inches above the ground, and brackets are secure)	—
Check _____	exhaust system (mounted securely, connected tightly, no signs of leaks such as soot trails)	—
Inspect _____	seat belts and tether belts	D28
_____	Remove chocks and test service brakes	D29
Inspector_____ Date _____		

Table 11.1, Daily Pretrip Inspection and Maintenance Checklist

Procedure Performed (check off)	Weekly Post-Trip Inspections/Checks	Procedure Reference
_____	Manually drain air reservoirs that are equipped with automatic drain valves	—
Inspect _____	batteries and battery cables	W1
Check _____	wheel bearing lubricant level	W2
Inspect _____	steering components	W3
Check _____	serpentine drive belt condition	W4
Check _____	V-belt tension	W5
Inspect _____	seat belts and tether belts	W6
Inspector_____ Date _____		

Table 11.2, Weekly Post-Trip Inspection and Maintenance Checklist

Procedure Performed (check off)	Monthly Post-Trip Inspections/Checks	Procedure Reference
_____	clean the battery terminals	M1
Inspect _____	radiator hoses and heater hoses	M2
Check _____	fluid level in the hydraulic clutch reservoir (if applicable, and if necessary, fill with DOT 4 brake fluid)	—
Check _____	steering wheel play	M3
Check _____	outer surfaces of the hood and body (for visible surface breaks and damage)	—
Check _____	hood tilt damper (attached at both ends)	—
Inspect _____	brake lining wear	M4
Inspect _____	driveshaft	—
Inspect _____	natural gas fuel system leak test, if equipped	M5
_____	drain the CNG high-pressure fuel filter housing, if equipped	M6
Inspector_____ Date _____		

Table 11.3, Monthly Post-Trip Inspection and Maintenance Checklist

Pretrip and Post-Trip Maintenance Procedures

Daily Pretrip Inspection and Maintenance

Whenever equipment requires adjustment, replacement, and/or repair, see the *Business Class® M2 Workshop Manual* for procedures and specifications. Specific references to the manual will be found where appropriate.

1. *Drain manually drained air reservoirs.*

   Water and oil normally enter the air reservoir in the form of vapor because of the heat generated during compression. After the water and oil condense, drain the resulting emulsion as follows:

   1.1 Open the wet tank valve. The drain cock or pull chain drain is located on the forward end of the supply air reservoir, which is connected directly to the air compressor. Block the valve open.

⚠ WARNING

When draining the air reservoir, do not look into the air jets or direct them toward anyone. Dirt or sludge particles may be in the airstream and could cause injury.

   1.2 Exhaust the remaining air and moisture from the system by opening the drain cocks on the bottoms of the remaining air reservoirs. Block the valves open.

1.3 Water and oil emulsion often form pockets that will not drain while compressed air is in the reservoirs. Because of these pockets, leave the valves blocked open during the first part of the pretrip inspection.

1.4 If the drained water is cloudy or oily, it may indicate a problem with the compressor. If oil is allowed to contaminate the air dryer, it will not remove the water from the air brake system, which could adversely affect braking.

2. *Check the fluid level in the windshield washer reservoir.*

   Add washer fluid as needed. Unscrew the cap to add fluid.

⚠ WARNING

Washer fluids may be flammable and poisonous. Do not expose washer fluid to an open flame or any burning material, such as a cigarette. Always comply with the washer fluid manufacturer's recommended safety precautions.

3. *Check the engine coolant levels in the radiator surge tank, and, if equipped, the reservoir for the hybrid cooling system.*

   See **Fig. 11.1**. If the coolant is low, add a 50/50 mixture of water and the type of antifreeze specified for your vehicle. Fill the surge tank with coolant to the MAX line when the tank is cool. If the surge tank was empty, start the engine after refilling and check the level again when the engine is at operating temperature.

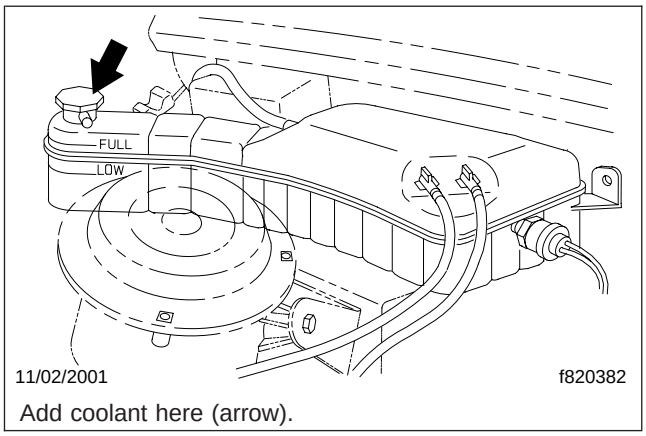
   For natural gas vehicles, use only Fleetguard ES Compleat™ EG Premix 50/50 engine coolant.

   For vehicles equipped with a hybrid cooling system, the coolant should be approximately 1.5 inches (4 cm) below the top of the reservoir for this system. If the coolant is low, add a 50/50 mixture of water and the type of antifreeze specified for your vehicle.

⚠ CAUTION

Coolant must be filled to the full line of the surge tank. Low coolant could result in engine overheating, which could cause engine damage.

4. *Inspect the radiator and charge air cooler.*



Add coolant here (arrow).

Fig. 11.1, Coolant Level Checking

4.1 Inspect the radiator and charge air cooler for clogged fins. Use compressed air or water directed from the fan side of the core to backflush any material restricting airflow.

4.2 Inspect the radiator and charge air cooler for damage and accumulated debris. Straighten bent or damaged fins to permit airflow across all areas of the cores.

NOTE: When traveling through areas of high insect concentration, it may be necessary to clean the exterior of the radiator or the charge air cooler core as often as every 200 miles (320 km).

4.3 On vehicles equipped with air conditioning, also inspect and clean the condenser. If clogged, the condenser can restrict airflow through the radiator.

4.4 Check the radiator for leaks. If leaks are found, have the radiator repaired or replaced. See **Group 20** of the *Business Class® M2 Workshop Manual* for instructions, or take the vehicle to an authorized Freightliner dealer.

5. *Inspect the engine and chassis wiring.*

   Check for loose wiring, chafed insulation, and damaged or loose hold-down clamps. Tighten loose wires or hold-down clamps; replace damaged wiring or clamps.

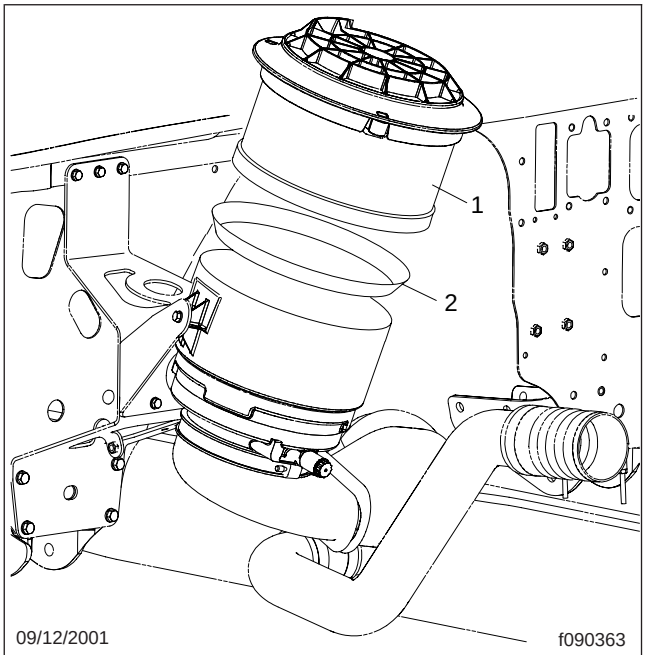
6. *Inspect the air intake system for leaks or damage.*

⚠ CAUTION

Failure to maintain a sealed air intake system could allow the entry of dirt and contaminants into the engine. This could adversely affect engine performance and result in engine damage.

6.1 Check the intake-air restriction indicator (if mounted in the air intake system).

6.2 Replace the primary filter element in the air cleaner (see **Fig. 11.2**) if the yellow signal stays locked at 25 inH_2O for Caterpillar engines or 20 inH_2O for Mercedes-Benz engines. See **Group 09** of the *Business Class® M2 Workshop Manual* for filter element replacement instructions.



1. Primary Filter Element
2. Secondary or Safety Filter Element

Fig. 11.2, Air Cleaner Filter Elements

NOTE: After replacing the filter element, reset the restriction indicator by pressing the rubber reset button.

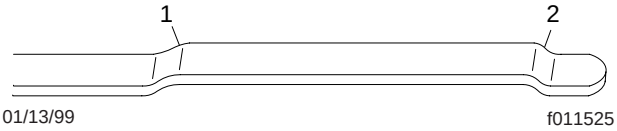
6.3 Inspect the secondary or safety filter element in the air cleaner when replacing the primary element, and replace it when clogged or dirty. This element should be replaced with every third primary element replacement.

6.4 Check the engine air intake piping from the air cleaner to the engine intake. Inspect the piping for loose connections, cracks, torn or collapsed hoses, punctures, and other damage. Tighten loose connections, and have damaged components replaced. Make sure the piping system is airtight so that all of the intake air passes through the air cleaner.

7. *Check the engine oil level.*

   If the oil level is at or below the minimum fill (or "add") mark on the dipstick, add enough oil to maintain the level between the minimum fill (or "add") and the maximum fill (or "full") marks on the dipstick. See **Fig. 11.3**. Engine lube oil must have a sulfated ash level less than 1.0 wt %; currently referred to as CJ-4 oil. Use the proper SAE viscosity rating for the temperature and time of year.

   For natural gas vehicles, use only Exxon Busgard® Geo 15W-40 natural gas engine oil. Busgard Geo engine oil with an SAE grade of 15W-40 has multiple benefits in natural gas vehicles, including improved cold-weather starting and pumping, and reduced oil consumption.



NOTE: The MBE900 dipstick is shown.

1. Maximum Fill Level
2. Minimum Fill Level

Fig. 11.3, Checking Engine Oil Level

⚠ CAUTION

Operating the engine with the oil level below the minimum fill (or "add") mark or above the maximum fill (or "full") mark could result in engine damage.

8. *Inspect the fuel tanks, fuel lines, and connections for leaks, and check the fuel level in the fuel tank(s).*

8.1 Check that the fuel tanks are secured to their mounting brackets and that the mounting brackets are secured to the frame.

8.2 Replace leaking fuel tanks.

8.3 If lines or connections are leaking, have them repaired or replaced.

For repair and/or replacement procedures, see **Group 47** of the *Business Class® M2 Workshop Manual*, or take the vehicle in to an authorized Freightliner dealer.

8.4 If equipped with fuel tank shutoff valves, be sure the valves are fully open.

⚠ WARNING

Never operate the engine with the fuel tank shut-off valves partly closed. This could damage the fuel pump, causing loss of engine power and reduced vehicle control.

8.5 Check the fuel level in the fuel tank(s).

To keep condensation to a minimum, fuel tanks should be filled at the end of each day. Federal regulations prohibit filling a fuel tank to more than 95 percent of its liquid capacity.

⚠ WARNING

Do not mix gasoline or alcohol with diesel fuel. This mixture could cause an explosion, possibly resulting in serious personal injury or death. Do not fill the fuel tanks in the presence of sparks, open flames, or intense heat. These could ignite the fuel, possibly causing severe burns.

IMPORTANT: Use ultralow-sulfur diesel (ULSD) with 15 ppm sulfur content or less, based on ASTM D2622 test procedure. Failure to use ultralow-sulfur diesel fuels may void the warranty on emission components.

8.6 Fuel should always be strained or filtered before being put into the tanks. This will lengthen the life of the engine fuel filter and reduce the chances of dirt getting into the engine.

8.7 Before installing the fuel cap, clean the area with a rag, or if necessary, clean the cap with solvent.

8.8 If needed, prime the fuel system. For priming procedures, see the applicable engine manufacturer's manual.

9. *If equipped with a fuel/water separator, check for water. Drain any water found. Check the fuel/water separator for leaks and contaminants.*

9.1 Place a suitable container under the fuel/water separator.

9.2 Check the water level in the sight bowl, if equipped, and loosen the filter vent at the top of the separator.

9.3 Drain the water by loosening the valve at the bottom and allowing the water to run out. Close and tighten the valve finger-tight.

9.4 Close and tighten the filter vent at the top of the separator.

IMPORTANT: When draining fluid from a fuel/water separator, drain the fluid into an appropriate container and dispose of it properly. Many states now issue fines for draining fuel/water separators onto the ground. On all types of separators, stop draining fluid when you see fuel come out of the separator drain valve.

10. *Inspect all natural gas fuel system components, if equipped, for damage or leaks. Replace components as necessary.*

10.1 Inspect fuel tanks for dents, scratches, gouges, or other signs of damage. Inspect the fuel lines and connections for leaks.

10.2 Check that the fuel tanks are securely mounted. Look for signs of abrasion between components.

CNG Fuel System: Ensure that the CNG fuel cylinder storage box is secured to the frame. Inspect for any signs of looseness.

LNG Fuel System: Ensure that the LNG fuel tank is secured to the mounting brackets and that the mounting brackets are secured to the frame. Inspect for any

signs of looseness. Ensure all rubber isolator straps are secure around the LNG fuel tank.

10.3 Check for the presence of all required decals. Natural gas decals should be present in the following locations:

- Left front bumper
- End-of-frame crossmember
- LNG fuel tank fill port (maximum psi), if equipped

10.4 Check for the presence of all necessary vent caps on pressure relief valves and devices.

CNG Fuel System: Check for the presence of blue caps on all pressure relief devices. Each fuel cylinder is equipped with two caps (one on each end), which are visible on the back of the CNG fuel cylinder storage box. One cap is located on the pressure relief valve on the inboard side of the CNG fuel box, next to the fuel outlet line. If any blue caps are missing, remove the vehicle from service and have the fuel system inspected by a qualified technician.

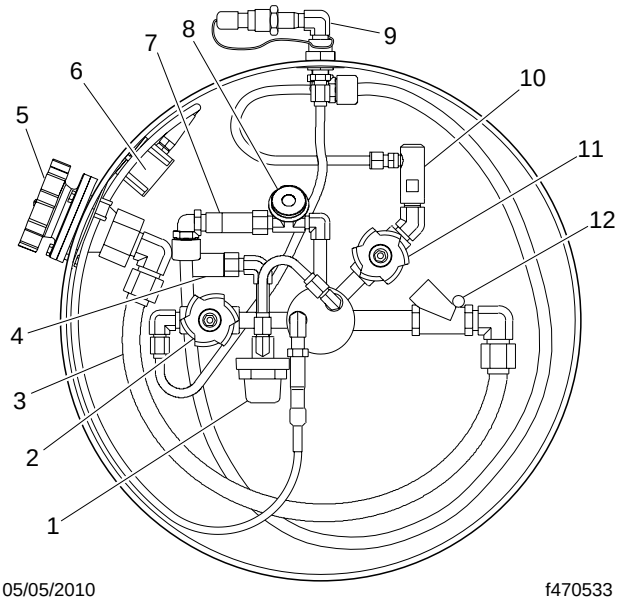
LNG Fuel System: Check for the presence of a red cap on the secondary relief valve. If the red vinyl cap is missing from the secondary relief valve (**Fig. 11.4**, Item 4), remove the vehicle from service and have the fuel system inspected by a qualified technician.

10.5 Inspect all plumbing components, including the fuel shutoff valve(s), primary and secondary relief valves, and the LNG vapor shutoff and excess flow valves, if equipped, for signs of damage or leaks. See **Fig. 11.4** or **Fig. 11.5**.

Inspect the fuel fill fitting for signs of damage or leaks.

Inspect all lines for signs of leaks or damage, and check all threaded connections.

10.6 Inspect all fuel gauge components for signs of leaks or damage. Inspect the LNG fuel level sender cable and wiring, if equipped.



1. Pressure Control Regulator
2. Vapor Shutoff Valve
3. Fuel Fill Hose
4. Secondary Relief Valve (red cap)
5. Fuel Fill Fitting
6. Fuel Level Sender Box
7. Primary Relief Valve
8. Tank Pressure Gauge
9. Fill Vent Fitting
10. Excess Flow Valve
11. Fuel Shutoff Valve (liquid)
12. Fill Check Valve

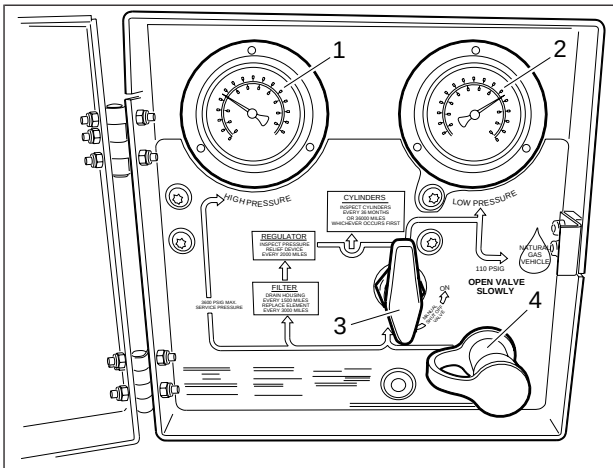
Fig. 11.4, LNG Tank Plumbing Components

10.7 Inspect all coolant hoses for signs of chafing, kinks, or leaks. The LNG fuel system utilizes coolant hoses between the engine and the vaporizer, while the CNG fuel system utilizes coolant hoses between the engine and the pressure regulator inside the fuel panel.

10.8 If equipped with an LNG fuel system, check the LNG fuel tank pressure gauge to ensure that pressure is within the normal range of 120 to 150 psi (827 to 1034 kPa). In the unlikely event that tank pressure exceeds 230 psi (1586 kPa) and the pressure relief valve does not open automatically, vent the tank immediately.

10.9 Inspect the LNG vaporizer, if equipped, for signs of damage or leaks. See **Fig. 11.6**.

Inspect the vaporizer mounting brackets for signs of looseness.



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1. High Pressure Gauge
2. Low Pressure Gauge
3. Manual Fuel Shutoff Valve
4. Fuel Fill Port

Fig. 11.5, CNG Fuel Panel

10.10 Inspect the LNG vaporizer overpressure regulator, if equipped, for signs of damage or leaks.

11. *Inspect the front and rear suspension components, including springs, spring hangers, shocks, and suspension brackets.*

    11.1 Check for broken spring leaves, loose U-bolts, cracks in the suspension brackets, and loose fasteners in the spring hangers and shackles.

    11.2 Inspect the shock absorbers for loose fasteners and leaks.

    11.3 Tighten all loose fasteners and have any component(s) replaced that are worn, cracked, or otherwise damaged.

    11.4 On vehicles with air suspensions, check for leaks. Check air suspension components for cuts and bulges.

12. *Clean the windshield, side, and rear windows with a long-handled or telescoping window cleaning device and standard cleaning solutions. Stand only on the ground, on a stepladder, or an elevated walkway. The cab entry/exit steps and handholds are not designed for this purpose. The tires, fenders, engine, and other under-hood components do not have adequate gripping surfaces and handholds.*

    Check the condition of the windshield wiper arms and blades.

    Be sure the windshield wiper blades are tensioned against the windshield.

    Inspect the wiper blades for damage and deteriorated rubber.

    Replace the wiper arms if the wiper blades are not tensioned against the windshield.

    Replace damaged or deteriorated wiper blades.

⚠ WARNING

When cleaning windshields and windows, always stand on the ground or on a secure ladder or platform. Use a long-handled window cleaner. Do not use the cab steps, tires, fenders, fuel tanks, engine, or under-hood components to access the windshield or windows. Doing so could cause a fall and result in an injury.

13. *After starting the engine, make sure the oil- and air-pressure warning systems are operating and that the buzzer stops sounding when the preset minimum is reached.*

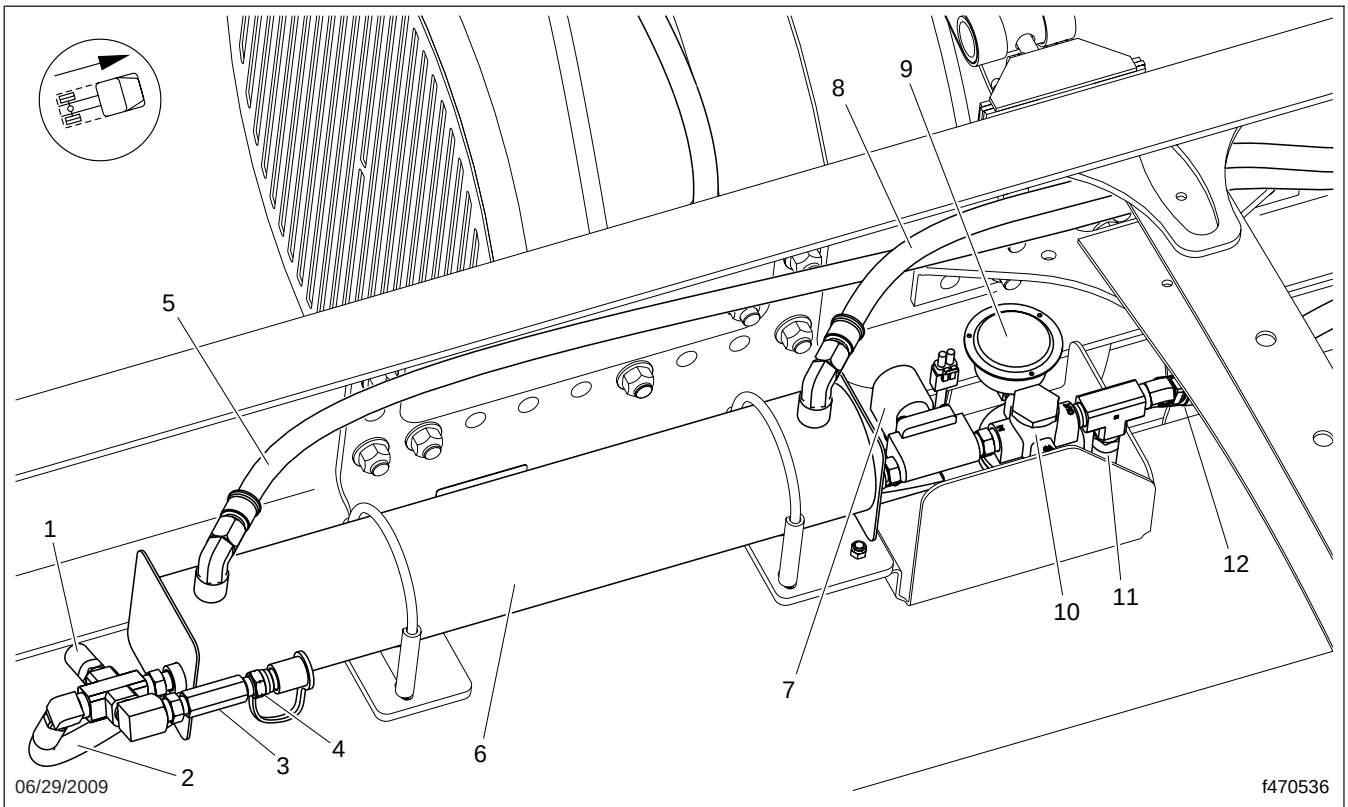
    If the warning systems do not come on when the ignition is turned on, have the systems repaired.

    The air pressure in both the primary and secondary air reservoir systems must be above 65 psi (448 kPa) on most vehicles. For vehicles with an optional Bendix dryer reservoir module (DRM), the cut-out pressure is 130 psi (896 kPa).

NOTE: If the air pressure in both systems is above the preset minimum when the engine is started, test the low air pressure warning system by lowering the pressure to below this range, or until the warning system comes on.

14. *Check the instrumentation control unit (ICU) for fault codes.*

    During the ignition sequence, if an active fault is detected in any device that is connected to the ECU, the message display screen will show the active fault codes, one after the other, until the parking brake is released or the ignition switch is turned off. See **Chapter 2** for detailed operating instructions for the ICU.



1. Pressure Relief Device
2. Fuel Inlet Line
3. Check Valve
4. CNG Quick-Connect Port
5. Coolant Inlet Line
6. Vaporizer
7. Fuel Shutoff Solenoid Valve
8. Coolant Outlet Line
9. Pressure Gauge
10. Overpressure Regulator
11. Pressure Relief Valve
12. Fuel Outlet Line

Fig. 11.6, LNG Vaporizer Assembly

15. *Make sure that the horn, windshield wipers, and windshield washers are operating properly. These devices must be in good working order for safe vehicle operation.*

    15.1 Make sure that the horn works. If a horn is not working, have it repaired before trip departure.

    15.2 Check the wiper and washer control on the multifunction turn signal switch. If the wipers and/or washers are not working, have them repaired before trip departure.

16. *During cold weather, make sure the heater, defroster, and optional mirror heat controls are operating properly. If so equipped, turn on the mirror heat switch and make sure the system is working.*

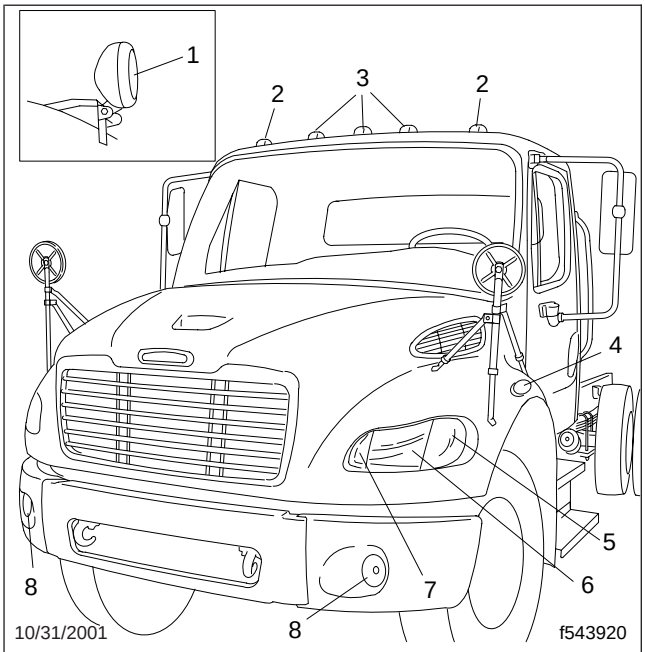
17. *Check the operation of all the panel lights and interior lights.*

    Turn on the headlights, dash lights, and four-way flashers and leave them on. If any of the gauge bulbs, the dome light bulbs, or the right- and left-turn indicator bulbs are not working, replace them.

18. *Make sure all the exterior lights are working properly.*

    Check that all the lights and reflectors are clean. See **Fig. 11.7**.

    18.1 Check that the brake lights, taillights, headlights, parking lights, turn signals, marker lights, identification lights, road lights (if so equipped), and front clearance lights are working properly and are clean.



NOTE: The parking lights, front clearance lights, and taillights all function as turn signals.

1. Utility Light
2. Identification Light
3. Marker Lights
4. Front Clearance Light
5. Headlight Low Beam
6. Headlight High Beam
7. Parking Light
8. Road Light

Fig. 11.7, Exterior Lights

18.2 Test the high and low beams of the headlights.

18.3 Replace light bulbs or sealed beam units that are not working.

18.4 Be sure all reflectors and lenses are in good condition and are clean. Replace any broken reflectors or lenses.

19. *Check tire inflation pressures using an accurate tire pressure gauge.*

Tires should be checked when cool. For inflation pressures and maximum loads (per tire) see the tire manufacturer's guidelines.

19.1 Be sure valve stem caps are on every tire and that they are screwed on finger-tight.

19.2 Inflate the tires to the applicable pressures if needed.

19.3 If a tire has been run flat or underinflated, check the wheel for proper lockring and side-ring seating, and possible wheel, rim, or tire damage before adding air.

Moisture inside a tire can result in body ply separation or a sidewall rupture. During tire inflation, compressed air reservoirs and lines must be kept dry. Use well-maintained inline moisture traps and service them regularly.

⚠ WARNING

Do not operate the vehicle with underinflated or overinflated tires. Incorrect inflation can stress the tires and make the tires and rims more susceptible to damage, possibly leading to rim or tire failure and loss of vehicle control, resulting in serious personal injury or death.

IMPORTANT: The load and cold inflation pressure must not exceed the rim or wheel manufacturer's recommendations, even though the tire may be approved for a higher load inflation. Some rims and wheels are stamped with a maximum load and maximum cold inflation rating. If they are not stamped, consult the rim or wheel manufacturer for the correct tire inflation pressure for the vehicle load. If the load exceeds the maximum rim or wheel capacity, the load must be adjusted or reduced.

⚠ CAUTION

A weekly pressure loss of 4 psi (28 kPa) or more in a tire may indicate damage. The tire should be inspected and, if necessary, repaired or replaced.

20. *Inspect each tire for wear, bulges, cracks, cuts, penetrations, and oil contamination.*

20.1 Check the tire tread depth. If tread is less than 4/32 inch (3 mm) on any front tire, or less than 2/32 inch (1.5 mm) on any rear tire, replace the tire.

20.2 Inspect each tire for bulges, cracks, cuts, and penetrations.

20.3 Inspect each tire for oil contamination. Fuel oil, gasoline, and other petroleum derivatives, if allowed to contact the tires, will soften the rubber and destroy the tire.

21. *Check the wheel nuts or rim nuts for indications of looseness. Examine each rim and wheel component.*

21.1 Remove all dirt and foreign material from the assembly. Dirt or rust streaks from the stud holes, metal buildup around stud holes, or out-of-round or worn stud holes may be caused by loose wheel nuts. See **Fig. 11.8** and **Fig. 11.9**.

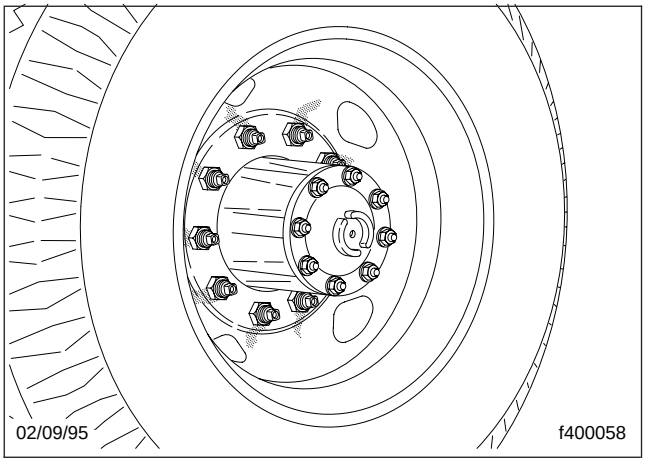


Fig. 11.8, Dirt and Rust Streaks from the Stud Holes

21.2 Examine the rim and wheel assembly components (including rims, rings, flanges, studs, and nuts) for cracks, or other damage.

See **Group 33** or **Group 35** of the *Business Class® M2 Workshop Manual* for service procedures on the studs and hubs, and see **Group 40** in the same manual for wheel and tire servicing, or take the vehicle to an authorized Freightliner dealer.

⚠ WARNING

Have any worn or damaged wheel components replaced by a qualified person using the wheel manufacturer's instructions and the wheel industry's standard safety precautions and equipment. Otherwise a vehicle or workshop accident could occur, possibly resulting in serious personal injury or death.

21.3 Have broken, cracked, badly worn, bent, rusty, or sprung rings and rims replaced. Be sure that the rim base, lockring, and side ring are matched according to size and type.

21.4 Make sure all wheel nuts are tightened 450 to 500 lbf·ft (610 to 678 N·m) for Accuride wheels with unlubricated threads. Use the tightening pattern in **Fig. 11.10** for 10-hole wheels and the tightening pattern in **Fig. 11.11** for 8-hole wheels. See **Group 40** of the *Business Class® M2 Workshop Manual* for more information.

NOTICE

Insufficient wheel nut torque can cause wheel shimmy, resulting in wheel damage, stud breakage, and extreme tire tread wear. Excessive wheel nut torque can break studs, damage threads, and crack discs in the stud hole area. Use the recommended torque values and follow the proper tightening sequence.

22. *Inspect the outboard side of all wheel hubs and the hub oil seal area on the inboard side of each wheel for signs of oil leakage.*

If any oil is found on wheel and tire or brake components, remove the vehicle from service until the leak has been repaired.

If needed, fill the hubs to the level indicated on the hub cap. See **Group 35** of the *Business Class® M2 Maintenance Manual* for recommended lubricants.

NOTE: Vehicles operating under severe or adverse conditions should be checked more frequently.

23. *Inspect the air brake chamber and the air brake chamber pushrods.*

⚠ WARNING

Do not operate the vehicle with the front brakes backed off or disconnected. Backing off or disconnecting the front brakes will not improve vehicle handling and may lead to loss of vehicle

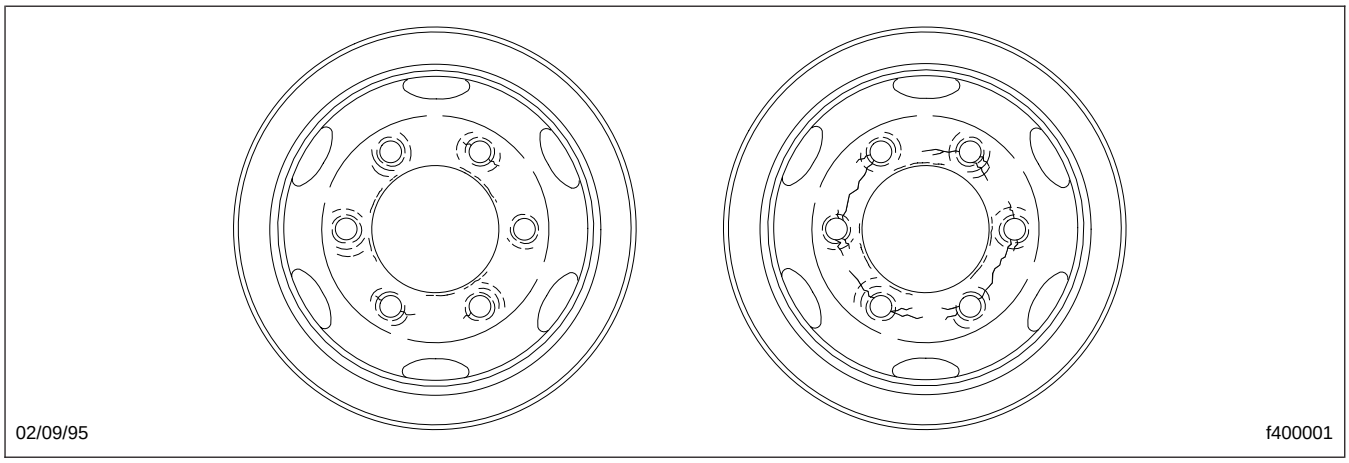


Fig. 11.9, Worn Stud Holes

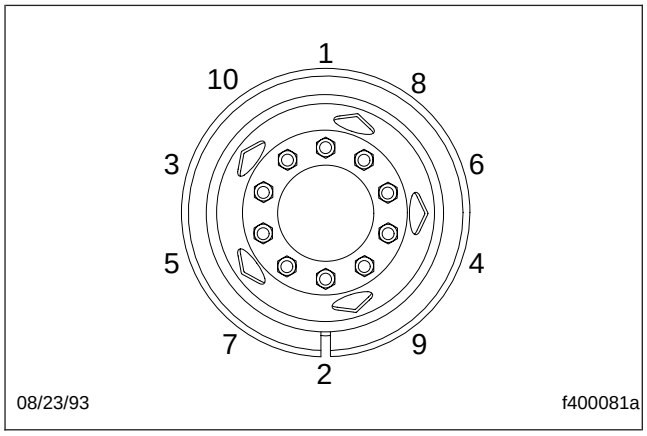


Fig. 11.10, Tightening Pattern, 10-Hole Wheels

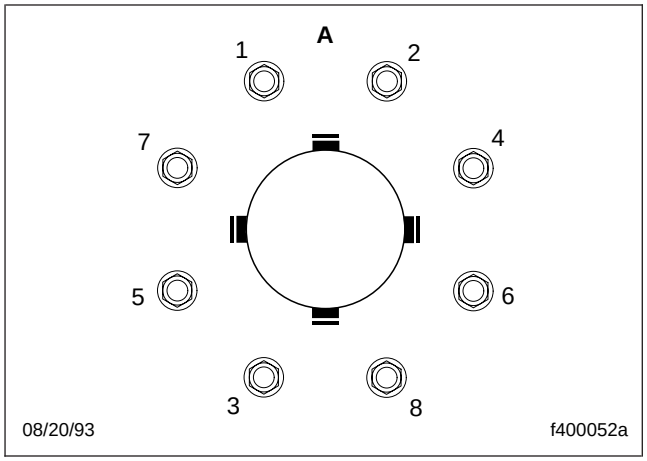


Fig. 11.11, Tightening Pattern, 8-Hole Wheels

control, resulting in property damage or personal injury.

23.1 Check that the air brake chamber is mounted securely on its mounting bracket, and that there are no loose or missing bolts.

23.2 Look for worn clevis pins on brake chamber pushrods and missing or damaged cotter pins on brake chamber pushrod clevis pins. Replace worn clevis pins and install new cotter pins if necessary.

23.3 See if the chamber piston rod is in line with the slack adjuster. Misalignment can cause the piston rod to rub on the non-pressure chamber and cause a dragging brake. See **Group 42** of the *Business Class® M2 Workshop Manual*.

⚠ CAUTION

If the external breather tube or breather cap is missing or incorrectly installed, road dirt and debris can adversely affect the operation of the brake chamber. Once inside of the chamber, dirt and debris can cause the internal parts of the chamber to deteriorate faster.

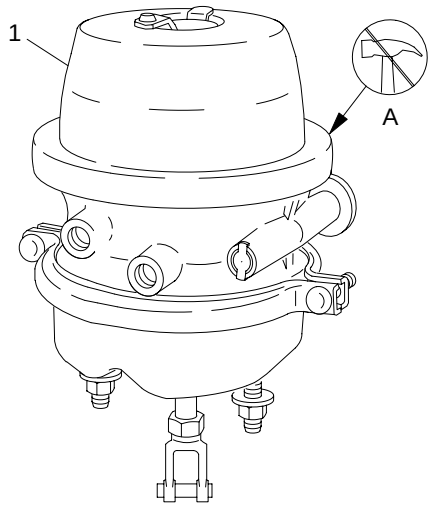
23.4 Inspect the exterior surfaces of the chamber for damage. Make sure that breather holes in the non-pressure section(s) are open and free of debris. See **Group 42** of the *Business Class® M2 Workshop Manual* to replace any damaged parts.

⚠ DANGER

Do not loosen or remove the parking brake clamp ring for any purpose. The parking/emergency brake section of the brake chamber is not intended to be serviced. Serious injury or death may result from sudden release of the power spring.

Before doing any repairs or adjustments on a service/parking brake chamber, read the applicable warnings and instructions in Group 42 of the ***Business Class® M2 Workshop Manual*.**

23.5 On all parking brake installations, make sure the end cover cap or dust plug is securely snapped into place. See **Fig. 11.12**.



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A. Do not remove this clamp ring.
1. MGM TR–T (TR Series) Brake Chamber shown

Fig. 11.12, Parking Brake Chamber Clamp

NOTE: On most MGM parking brake chambers equipped with an integral release bolt, an end cover cap is installed over the release bolt.

23.6 Check for rusted connections, missing snap rings, and damaged camshaft grease seals. Have damaged or missing parts repaired or replaced.

24. *Inspect the air brake lines.*

24.1 Check the clearance between the hoses and the exhaust manifold or other hot spots. Excessive heat will cause material in the hoses to deteriorate rapidly or become brittle. Provide at least 6 inches (150 mm) of clearance. More clearance is recommended if the hose is located above the heat source.

24.2 Check for kinks, dents, or swelling of the hoses. If damaged, have the hose replaced with the same size and type.

NOTE: Do not route the hose on top of anything likely to be stepped on.

24.3 Check for damage to hoses located near moving parts, such as drivelines, kingpins, suspensions, and axles. If moving parts are catching or pinching the lines, correct as needed.

24.4 Check for hose damage caused by abrasion. If abraded, have the hose replaced. Check for the cause of abrasion, such as loose or damaged hose clamps. Have the clamps repaired or replaced as needed.

24.5 Observe the hose cover condition, especially hoses exposed to water splash and ice. If dried out or ragged (the wire or liner is showing through the cover), have the hose(s) replaced.

24.6 Inspect the air tubing, especially tubing made of nylon. In cold weather, nylon tubing is sensitive to damage, such as nicks or cuts. Have nicked or cut tubing replaced, even if it is not leaking.

24.7 Check for kinked or twisted hoses. A seven-percent twist in the hose can reduce its life by up to 90 percent. A twisted hose under pressure tends to untwist, which may loosen the fitting. Reconnect hoses that are twisted.

NOTE: The front brake lines flex continuously in vehicle operation, so they require special examination. Give particular attention to the areas near where they connect to the front air brake chambers. This inspection requires two people, one in the driver seat

and another to inspect the brake line connections at the wheels.

24.8 Both wheel air lines must be inspected with the emergency brake set, engine idling, air pressure at 80 to 90 psi (550 to 620 kPa), and the brake pedal held down.

24.9 Turn the wheels to full lock in one direction and inspect both air lines where they connect to the air chambers, then turn the wheels to full lock in the other direction and inspect both lines. If a hose is leaking, have it replaced.

IMPORTANT: ABS-equipped vehicles operating in regions where especially corrosive ice-removal chemicals are used may experience higher than normal rotor corrosion. Tone rings should be routinely inspected for corrosion. Severe corrosion of the integral ABS tone ring may cause the ABS warning lamp in the dash to illuminate due to false wheel speed readings. If the ABS warning lamp illuminates at any time other than at vehicle start-up, have the problem repaired immediately.

25. *Inspect the slack adjusters.*

25.1 *Meritor Slack Adjusters:* Check the boot for cuts, tears, or other damage. Have it replaced if necessary.

25.2 *Gunite Slack Adjusters:* Inspect the slack adjuster for any signs of damage. If damaged, have the slack adjuster replaced.

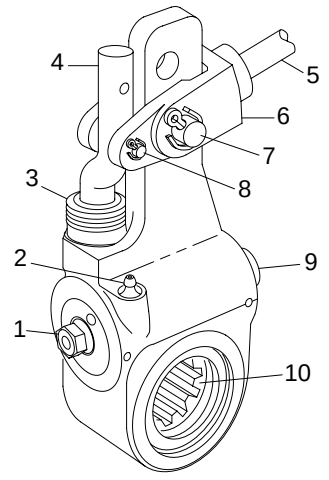
Inspect the slack adjuster boot for cuts or tears. If the boot is damaged, have it replaced. See **Fig. 11.13**.

25.3 *Haldex Slack Adjusters:* Inspect each slack adjuster and anchor strap for damage. See **Fig. 11.14**. Have any damaged components replaced.

26. *Check the air brake system for proper operation.*

26.1 Check the air governor cut-in and cut-out pressures as follows.

Run the engine at fast idle. The air governor should cut out the air compressor at approximately 120 psi (827 kPa). With the engine idling, apply the brake pedal several times. The air governor should cut in the air compressor at approximately 100 psi (689 kPa). If the air governor does not cut in and out as described above, it must be adjusted to these specifications. If the air governor cannot be adjusted or repaired, replace it before operating the vehicle.



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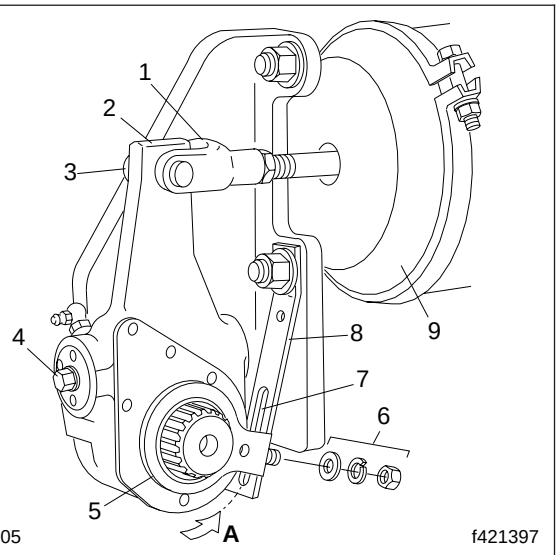
1. 7/16-inch Adjusting Nut
2. Grease Fitting
3. Boot
4. Link
5. Brake Chamber Piston Rod
6. Clevis
7. 1/2-inch Clevis Pin
8. 1/4-inch Clevis Pin
9. Grease Relief Opening
10. Slack Adjuster Spline

Fig. 11.13, Gunite Automatic Slack Adjuster

26.2 Check the air pressure buildup time as follows.

With the air system fully charged to 120 psi (827 kPa), make one full brake application and note the air pressure reading on the gauge. Continue to reduce the air pressure by moderate brake applications to a maximum of 90 psi (620 kPa), then run the engine at governed rpm. If the time required to raise the air pressure to 120 psi (827 kPa) (from the pressure noted after one brake application) is more than 30 seconds, eliminate any leaks or replace the air compressor before operating the vehicle.

26.3 Check the air pressure reserve as follows.



A. Rotate the control arm toward the brake chamber until you can feel it contacting the internal stop.

1. Clevis
2. Slack Adjuster
3. Clevis Pin
4. Manual Adjusting Nut
5. Control Arm
6. Control-Arm Washers and Nut
7. Anchor Strap Slot
8. Anchor Strap
9. Brake Chamber

Fig. 11.14, Haldex Automatic Slack Adjuster

With the air system fully charged to 120 psi (827 kPa), stop the engine and note the air pressure. Then make one full brake application and observe the pressure drop. If it drops more than 25 psi (172 kPa), all areas of leakage must be eliminated before operating the vehicle.

26.4 Check the air leakage in the system as follows.

With the parking brake (spring brake) applied, the transmission out of gear, and the tires chocked, charge the air system until cut-out pressure of 120 psi (827 kPa) is reached.

With the service brakes released, shut down the engine, wait 1 minute and note the air pressure gauge reading. Observe the air pressure drop in psi (kPa) per minute.

Charge the air system until cut-out pressure of 120 psi (827 kPa) is reached. With the parking brakes released and the service brake applied, shut down the engine, wait 1 minute and note the air pressure gauge reading. Observe the air pressure drop in psi (kPa) per minute.

If leakage exceeds the limits shown in **Table 11.4**, repair all areas of leakage before driving the vehicle.

Maximum Allowable Service Brake Air Leakage		
Description	**Air Leakage in psi (kPa) Per Minute**	
	Released	**Applied**
Truck or Tractor Only	2 (14)	3 (21)
Truck or Tractor w/Single Trailer	3 (21)	4 (28)
Truck or Tractor w/Two Trailers	5 (35)	6 (42)

Table 11.4, Maximum Allowable Service Brake Air Leakage

27. *Check the operation of the Bendix Hydro-Max® brake booster, if equipped, as follows.*

27.1 With the engine off, depress the brake pedal; the warning light and buzzer should come on, and the electric motor should run.

27.2 Start the engine and allow the gauges to sweep. Depress the brake pedal; no warning lights, buzzer, or electric motor should come on.

28. *Inspect the seat belts and tether belts.*

⚠ WARNING

Inspect and maintain seat belts. When any part of a seat belt system needs replacement, the entire seat belt must be replaced, both retractor and buckle side. Any time a vehicle is involved in an accident, and the seat belt system was in use, the entire vehicle seat belt system must be replaced before operating the vehicle. Do not attempt to modify the seat belt system; doing so could change the effectiveness of the system. Failure to replace worn or damaged seat belts, or making any modifications to the system, may result in personal injury or death.

28.1 Check the web for fraying, cuts, extreme dirt and dust, or for severe fading from exposure to sunlight, especially near the buckle latch plate and in the D-loop guide area.

28.2 Check operation of the buckle, latch, Komfort Latch or Sliding Komfort Latch (if equipped), web retractor, and upper seat belt mount on the door pillar. Check all visible components for wear or damage.

28.3 Check the seat belt and tether belt connection points and tighten any that are loose.

29. *Test the service brakes.*

When starting to move the vehicle and before picking up speed, test the brakes with the foot pedal and parking brake control valve (yellow knob) to be sure they will bring the vehicle to a safe stop.

Weekly Post-Trip Inspection and Maintenance

⚠ WARNING

Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. To prevent possible personal injury, always wash your hands after handling battery parts and related accessories.

1. *Inspect the batteries and battery cables.*

1.1 Access the batteries. Be sure the battery hold-down is secure. If it is loose, tighten the hold-down bolts; if it is broken, replace it.

1.2 If the battery is equipped with a built-in hydrometer, examine the hydrometer. If a green dot shows in the sight glass, the battery is sufficiently charged.

If the sight glass is dark, the charge is low and the battery must be recharged.

If the sight glass is clear, the battery has a low level of electrolyte and must be replaced.

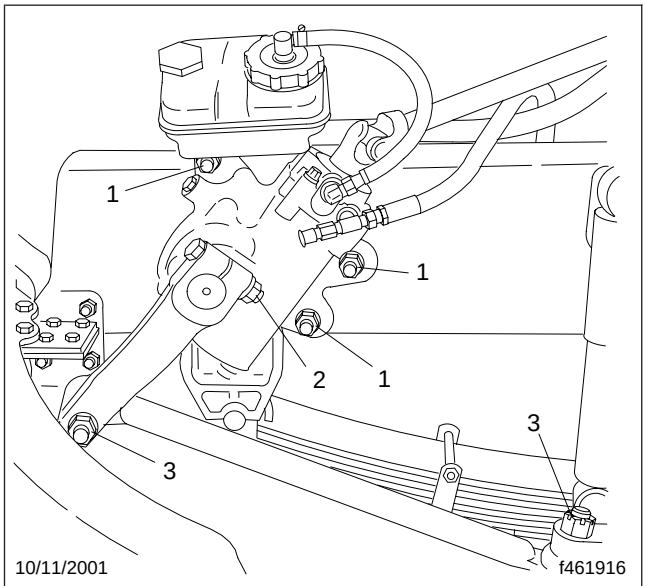
2. *Check the level of the wheel bearing lubricant in the hub cap at each end of the front axle.*

If needed, fill the hubs to the level indicated on the hub cap. See **Group 35** of the *Business Class® M2 Maintenance Manual*, for recommended lubricants.

IMPORTANT: Before removing the fill plug, always clean the hub cap and plug.

3. *Examine the steering components.*

See **Fig. 11.15**. If repairs are needed, see **Group 46** of the *Business Class® M2 Workshop Manual* for instructions, or take the vehicle to an authorized Freightliner dealer.



1. Steering Gear Mounting Bolt
2. Pitman Arm Pinch Bolt Nut
3. Drag Link Nut

Fig. 11.15, Steering Gear Fasteners

3.1 Check the mounting bolts and pitman arm nut for tightness.

3.2 Check the drag link nuts for missing cotter pins.

3.3 Inspect the steering drive shaft and steering linkage for excessive looseness, or other damage.

3.4 Tighten loose nuts and have damaged parts replaced as needed.

4. *Check the condition of the serpentine drive belt.*

   Look for signs of glazing, wear (frayed edges), damage (breaks or cracks), or oil contamination. If a belt is glazed, worn, damaged, or oil soaked, have the belt replaced, following the instructions in **Group 01** of the *Business Class® M2 Workshop Manual.*

NOTICE

Do not drive with a serpentine belt that is visibly worn or damaged. If it fails, the lack of coolant flow could rapidly cause damage to engine components.

5. *Check the drive belt for proper tension.*

   Use your index finger to apply force at the center of the belt free-span. See **Fig. 11.16**. There is no adjustment for belt tension on engines with automatic belt tensioners. If there is not proper tension, have the belt tensioner replaced. See **Group 01** of the *Business Class® M2 Workshop Manual* for instructions, or take the vehicle to an authorized Freightliner dealer.

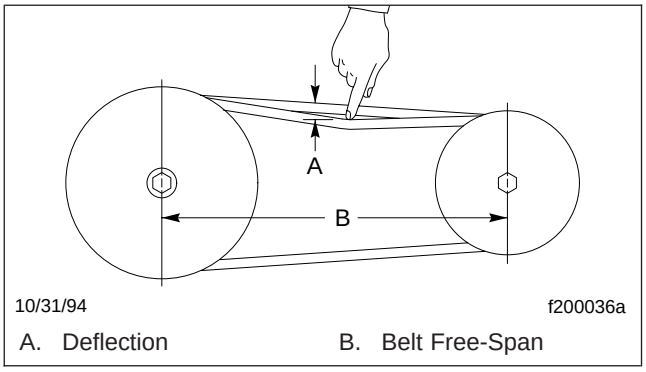


Fig. 11.16, Checking Belt Tension

Monthly Post-Trip Inspection and Maintenance

⚠ WARNING

Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. To prevent possible personal injury, always wash your hands after handling battery parts and related accessories.

1. *Clean the batteries.*

   1.1 Remove any corrosion from the hold-down and the top of the battery.

NOTICE

Take care to keep the vent plugs tight so that the neutralizing solution does not enter any of the battery cells and damage the battery.

   1.2 Use a soda solution to neutralize the acid present, then rinse off the soda solution with clean water.

   1.3 If the battery posts or cable terminals are corroded, disconnect the terminals from the posts. Clean them with a soda solution and a wire brush. After cleaning, connect the terminals to the battery posts, then apply a thin coat of petroleum jelly to the posts and terminals to help retard corrosion.

2. *Inspect the radiator and heater hoses, including the clamps and support brackets.*

   2.1 Make sure the radiator inlet and outlet hoses are pliable and are not cracking or ballooning. Replace hoses that show signs of cracking, weakening, or ballooning.

   2.2 Make sure the heater hoses are pliable and are not cracking or ballooning. Replace hoses that show signs of cracking, weakening, or ballooning.

   2.3 Tighten hose clamps as necessary, but do not overtighten, as hose life can be adversely affected.

   2.4 Be sure the hose support brackets are securely fastened. Make sure the hoses are not located near sources of wear, abrasion, or high heat.

IMPORTANT: Replace all hoses, including heater hoses, at the same time. Service-type knitted or braided yarn-reinforced neoprene hose is acceptable. Silicone hoses having an extended service life can be substituted for the reinforced neoprene type. See the Freightliner *Service Parts Catalog* or contact your Freightliner Dealer.

3. *Check the steering wheel for excessive play.*

3.1 Start the engine. With the front tires straight ahead, turn the steering wheel until motion is observed at the front wheels.

3.2 Align a reference mark on a ruler, then slowly turn the steering wheel in the opposite direction until motion is again detected at the wheels.

3.3 Check the lash (free play) at the rim of the steering wheel. See local/federal regulations for acceptable ranges of lash.

If there is excessive lash, check the steering system for wear or incorrect adjustment of the linkage and steering gear before operating the vehicle.

4. *Check the brake lining wear on all vehicles, including those with automatic slack adjusters. Proper brake operation is dependent on periodic maintenance and inspection of the brake linings.*

4.1 Check that brake linings are free of oil and grease.

4.2 Inspect the thickness of the brake linings. If the axle assembly is equipped with a dust shield or backing plate, remove the inspection plugs. If *any* brake linings are worn to less than approximately 1/4 inch (6.4 mm) at the thinnest point, have the linings replaced on *all* brake assemblies on that axle. See **Group 42** of the *Business Class® M2 Workshop Manual* for lining replacement instructions and camshaft end-play inspection.

4.3 Check the brake drums for wear and cracks.

4.4 Check that the inspection plugs in the dust shields or backing plates, if so equipped, are installed.

5. *Leak test the natural gas fuel system, if equipped.*

Use a methane detector to test all fuel system components, joints, and fittings for leaks. A bubble solution can be used to pinpoint the exact location of leaks.

Replace any leaking or damaged fuel tanks and fuel lines; repair or replace leaking or damaged fittings.

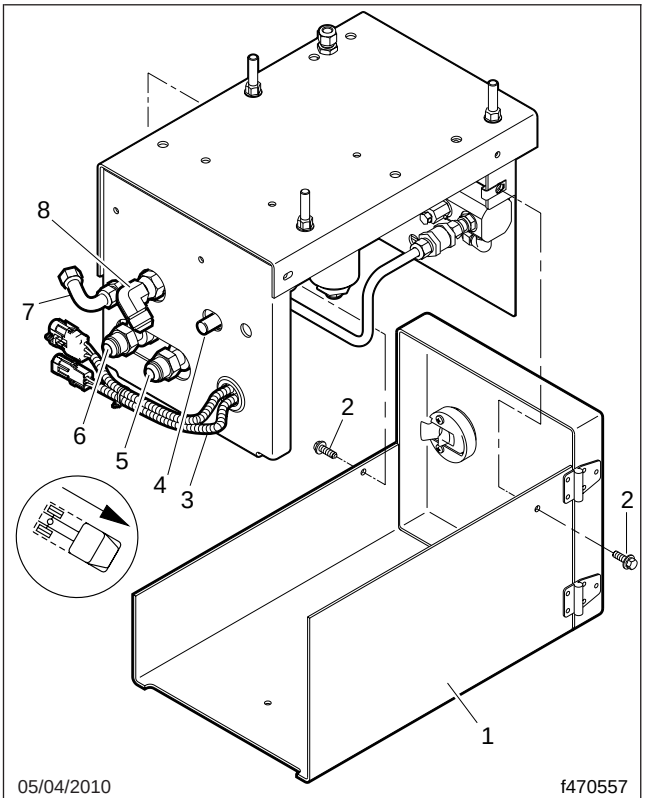
6. *Drain the CNG high-pressure fuel filter housing, if equipped.*

6.1 Purge the CNG fuel lines by closing the CNG fuel cylinder shutoff valves. Start the engine and let it idle until the fuel lines are empty and the engine stops.

Gauges on the fuel panel should now read at or near 0 psi (0 kPa).

6.2 Close the manual fuel shutoff valve on the fuel panel.

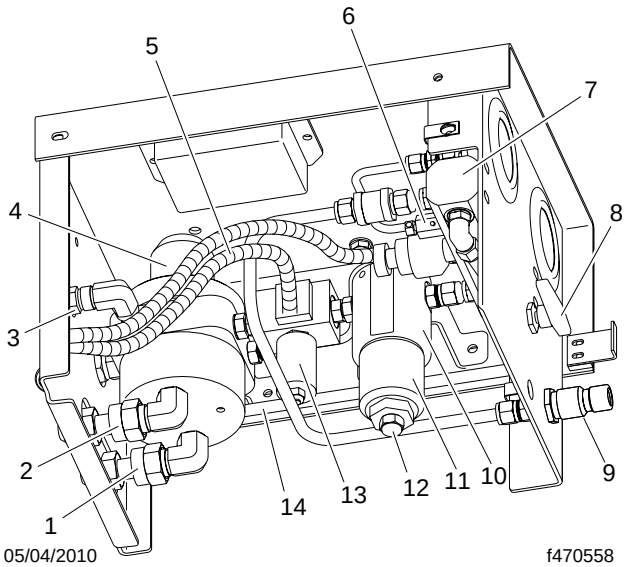
6.3 Remove the two capscrews that secure the access cover to the fuel panel, then remove the access cover. See **Fig. 11.17**. Save the capscrews for installation.



1. Fuel Panel Access Cover
2. Capscrews (qty 2)
3. Wiring Harness
4. Pressure Relief Valve and Cap
5. Coolant Outlet Line
6. Coolant Inlet Line
7. Fuel Inlet Line (to fuel cylinders)
8. Fuel Outlet Line (to engine)

Fig. 11.17, CNG Fuel Panel Assembly

6.4 Slowly open the bleed valve on the manifold to relieve remaining fuel pressure within the system. See **Fig. 11.18**.



1. Coolant Inlet Port
2. Coolant Outlet Port
3. Pressure Relief Valve
4. Pressure Regulator
5. Wiring Harness
6. Manifold Bleed Valve
7. Manifold
8. Manual Fuel Shutoff Valve
9. Fuel Fill Port
10. Filter Housing
11. Filter Bowl
12. Filter Drain Plug
13. Solenoid Valve
14. Fuel Line To Cylinders

Fig. 11.18, CNG Fuel Panel Components

IMPORTANT: Some pressure may remain in the fuel system between the solenoid valve and the engine. Use caution when loosening fittings, as a small amount of gas may leak out.

6.5 Put a clean receptacle under the filter assembly.

6.6 Using an 11/16-inch wrench, remove the drain plug from the filter bowl.

When all liquid has drained, install and tighten the drain plug on the filter bowl.

6.7 Close the bleed valve on the manifold and open the manual fuel shutoff valve on the fuel panel.

Open the fuel cylinder shutoff valves.

6.8 Use a methane detector to leak test all fuel system components between the fuel cylinders and the solenoid valve. A bubble solution can be used to pinpoint the exact location of leaks.

Repair or replace any leaking components.

6.9 Using the two capscrews removed in substep 6.3, install the access cover on the fuel panel.

12

Cab Appearance

Cab Washing and Polishing 12.1
Care of Fiberglass Parts 12.1
Care of Chrome Parts 12.1
Care of Exterior Lights 12.1
Dashboard Care 12.1
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Cab Appearance

Cab Washing and Polishing

⚠ CAUTION

When pressure washing the vehicle or leaving the hood open when parked outdoors and subject to rain, cover the air cleaner inlet with a plastic bag to prevent water from entering the air intake system and possibly damaging the engine.

To protect the finish of your new vehicle, follow these guidelines carefully:

- During the first 30 days, rinse your vehicle frequently with water. If the vehicle is dirty, use a mild liquid soap. Do not use detergent.
- During the first 30 days, do not use anything abrasive on your vehicle. Brushes, chemicals, and cleaners may scratch the finish.
- During the first 120 days, do not wax your vehicle.

To extend the life of your vehicle's finish, follow these guidelines:

- Avoid washing your vehicle in the hot sun. Always use water. After the cab is completely washed, dry it with a towel or chamois.
- Do not dust painted surfaces with a dry cloth, as this will scratch the paint.
- Do not remove ice or snow from a painted surface with a scraper of any sort.
- To prevent damage to the finish, wax it regularly. If the finish has become dull, before waxing, remove oxidized paint using a cleaner specifically designed for this purpose. Remove all road tar and tree sap before waxing. Freightliner recommends that a quality brand of cleaner or cleaner-polish and polishing wax be used.
- Do not let diesel fuel or antifreeze stand on a painted surface. If either should occur, rinse the surface off with water.
- To prevent corrosion, have any nicks or other damage on the finish touched up as soon as possible.
- Park your vehicle in a sheltered area whenever possible.

Care of Fiberglass Parts

Wash unpainted fiberglass air fairings and shields monthly with a mild detergent, such as dishwashing liquid. Avoid strong alkaline cleansers.

Apply a wax specifically designed for fiberglass.

Care of Chrome Parts

To prevent rust, keep chrome parts clean and protected at all times. This is especially important during winter driving and in coastal areas where there is exposure to salt air.

When cleaning chrome parts, use clean water and a soft cloth or sponge. A mild detergent may also be used.

Sponge gently, then rinse. If necessary, use a non-abrasive chrome cleaner to remove stubborn rust or other material. Do not use steel wool.

To help protect the chrome after cleaning, apply a coat of polishing wax to the surface. Never use wax on parts that are exposed to high heat, such as exhaust pipes.

Care of Exterior Lights

Clean the headlight lenses by hand only, using a flannel cloth with mild, non-caustic soap or detergent, and water.

⚠ CAUTION

Do not use a power buffer, paper towels, chemical solvents, or abrasive cleaners on the headlight lens, all of which can remove the UV coating from the surface, and result in yellowing of the lens.

Dashboard Care

Periodically wipe the dashboard with a water-dampened cloth. A mild detergent can be used, but avoid using strong detergents.

⚠ CAUTION

Do not use Armor-All Protectant®, STP Son-of-a-Gun®, or other equivalent treatments. These cleaners contain vinyl plasticizers that can cause

stress crazing in the interior plastic panels, which can result in cracking of the panels.

Vinyl Upholstery Cleaning

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Harsh cleaning agents can cause permanent damage to vinyl upholstery. To preserve the upholstery and prevent damage, carefully review the following sections for recommended cleaning procedures. Waxing or refinishing improves soil resistance and cleanability for all vinyls. Any hard wax, such as that used on automobiles, may be used.

Ordinary Dirt

Wash the upholstery with warm water and mild soap, such as saddle or oil soap. Apply soapy water to a large area and allow to soak for a few minutes, then rub briskly with a cloth to remove the dirt. This can be repeated several times as necessary.

If dirt is deeply imbedded, use a soft bristle brush after applying the soap.

If dirt is extremely difficult to remove, wall-washing preparations normally found around the home can be used. Powdered cleaners, such as those used for sinks and tiles, are abrasive and must be used with caution as they can scratch the vinyl or give it a permanent dull appearance.

Chewing Gum

Harden the gum with an ice cube wrapped in a plastic bag, then scrape it off with a dull knife. Any remaining traces of gum can be removed with an all-purpose light oil (peanut butter will also work) and wiped off.

Tars, Asphalts, and Creosote

Tars, asphalts, and creosote stain vinyl after prolonged contact. They should be wiped off immediately and the area carefully cleaned, using a cloth dampened with naphtha.

Paint, Shoe Heel Marks

Paint should be removed immediately. Do not use paint remover or liquid-type brush cleaner on vinyl. An unprinted cloth, dampened with naphtha or turpentine may be used. Use care to prevent contact with parts of the upholstery that are not vinyl.

Sulfide Stains

Sulfide compounds, such as those found in eggs and some canned goods, can stain after prolonged contact with vinyl. These stains can be removed by placing a clean, unprinted piece of cloth over the spotted area and pouring a liberal amount of 6 percent hydrogen peroxide onto the cloth. Allow the saturated cloth to remain on the spot for 30 to 60 minutes. For stubborn spots, allow the hydrogen-peroxide saturated cloth to remain on the area overnight. Use caution to prevent the solution from seeping into the seams or it will weaken the cotton thread.

Nail Polish and Nail Polish Remover

Prolonged contact with these substances causes permanent damage to vinyl. Careful blotting immediately after contact minimizes damage. Do not spread the liquid during removal.

Shoe Polish

Most shoe polishes contain dyes which penetrate vinyl and stain it permanently. Shoe polish should be wiped off as quickly as possible using naphtha or lighter fluid. If staining occurs, try the procedure used for sulfide stains.

Ball Point Ink

Ball point ink can sometimes be removed if rubbed immediately with a damp cloth, using water or rubbing alcohol. If this does not work, try the procedure used for sulfide stains.

Miscellaneous

If stains do not respond to any of the treatments described above, it is sometimes helpful to expose the vinyl to direct sunlight for up to 30 hours. Mustard, ball point ink, certain shoe polishes, and dyes often bleach out in direct sunlight leaving the vinyl undamaged.

Velour Upholstery Cleaning

To prevent soiling, frequent vacuuming or light brushing to remove dust and dirt is recommended. Spot clean with a mild solvent or an upholstery shampoo,

or the foam from a mild detergent. When using a solvent or a dry-cleaning product, follow the instructions carefully and clean only in a well-ventilated area. Avoid any product that contains carbon tetrachloride or other toxic materials. With either method, pretest a small area before proceeding. Use a professional upholstery cleaning service when extensive cleaning is needed.

Grease and Oil-Based Stains

Dampen a small absorbent cloth with dry-cleaning solvent or spot remover. Apply the cloth carefully to the spot from the outer edge to the center. Pat and blot the spot with a clean, dry cloth. Repeat several times, as necessary, turning the cloths so that the stain does not redeposit on the fabric.

Sugar and Water-Based Stains

Apply water-based detergent or cleaner, working in circular motions. Pat and blot as dry as possible. Repeat if necessary before drying thoroughly.

Chewing Gum or Wax

Harden the gum or wax with an ice cube wrapped in a plastic bag, then scrape it off with a dull knife. Excess wax can be absorbed by placing a thick white blotter over the wax and heating with a warm (not hot) iron. Remove the remainder by using the procedure for grease and oil-based stains.

Mildew

Brush the dry fabric with a soft brush. Sponge with detergent, and blot. If the fabric is colorfast, dilute a teaspoon of bleach in one quart (one liter) of cool water. Apply with a swab, directly on the mildew stain. Dab repeatedly with clear, cool water, and blot dry.

13

In an Emergency

Hazard Warning Lights 13.1
Fire Extinguisher 13.1
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Emergency Filter Replacement, Davco 13.1
Emergency Starting With Jumper Cables 13.2
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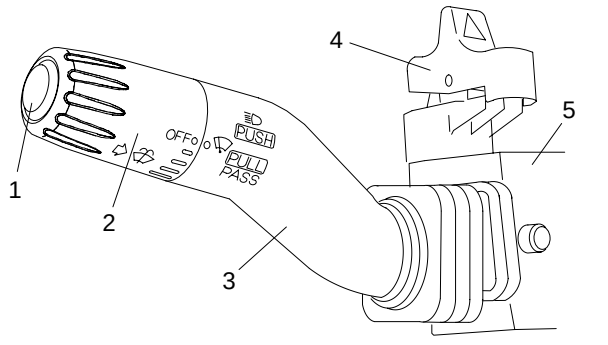
Hazard Warning Lights

The hazard warning light flasher (**Fig. 13.1**) is part of the multifunction turn signal switch. It is a red rocker switch located on the top of the multifunction switch module.



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Press down on the upper part of the rocker to activate the flashers.

1. Washer Button
2. Wiper Control Dial
3. Turn Signal Lever
4. Hazard Flasher (red)
5. Multifunction Switch Module

Fig. 13.1, Hazard Warning Flashers

To flash the hazard warning lights, press down on the upper part of the rocker (towards the dash). To stop the hazard warning lights, press down on the lower part of the rocker (towards the steering wheel).

Fire Extinguisher

A fire extinguisher is located in the cab by the driver's door.

Emergency Kit, Optional

An optional emergency kit is located in the cab. The kit includes one or more of the following: a first aid kit, a reflective vest, a triangular reflector, a flare kit, and (on vehicles with a Davco fuel/water separator) a spin-on fuel filter element.

If there is an emergency while driving, cautiously pull off the road. Turn on the hazard warning lights. Place the flares and reflector along the side of the road to alert other drivers that an emergency situation exists.

⚠ WARNING

Use extreme care when placing flares in emergency situations that involve exposure to flammable substances such as fuel. An explosion or fire could occur causing serious personal injury.

Emergency Filter Replacement, Davco

If the filter cover on the Davco fuel/water separator is broken, it will not be possible to operate the vehicle. A standard spin-on filter will correct this problem.

Refer to the Davco web site for additional information, **www.davcotec.com**.

To replace the filter on all Davco fuel/water separators, follow these procedures:

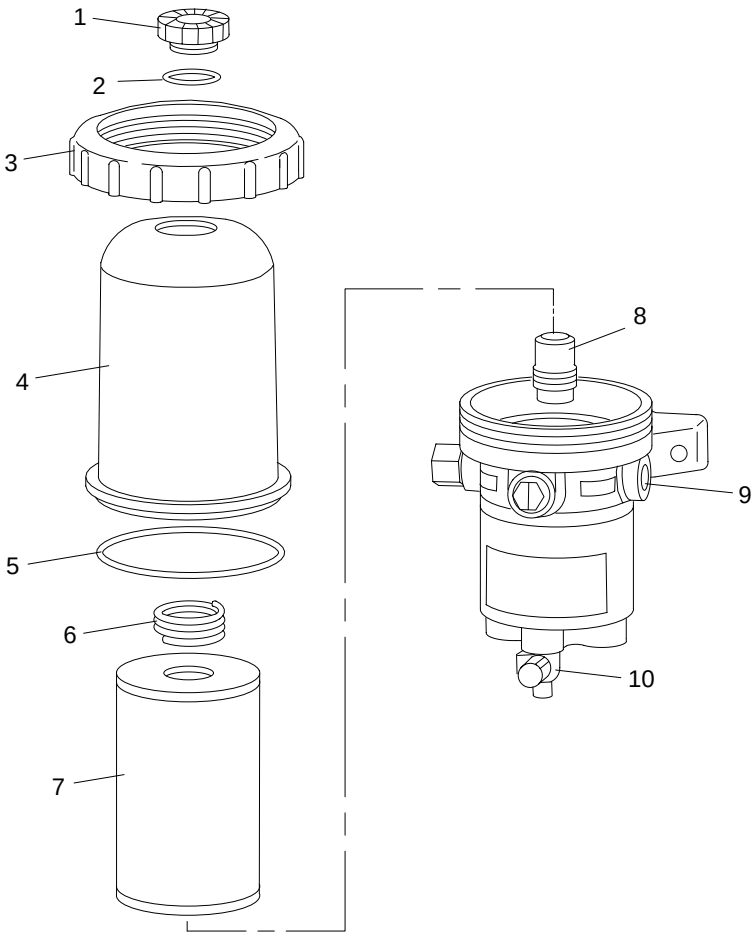
1. Drain the fuel until it is below the level of the filter collar. See **Fig. 13.2** for the model 232/233 fuel/water separator and **Fig. 13.3** for the model 382 fuel/water separator.
2. Remove the filter vent and vent seal.

NOTE: The filter vent and vent seal are not needed in the emergency replacement. They should be retained for later installation at the time when the filter cover is replaced.

3. Remove the filter collar using channel-lock pliers.
4. Remove the filter cover, filter cover seal and spring. Retain them for later assembly.
5. Remove the filter element and dispose of it properly.
6. Install the standard engine spin-on filter (included in the emergency kit) on the threaded stud.

NOTE: Remove the rubber grommet from the stud.

7. Install the filter cover, filter cover seal, and spring, as removed.
8. Install the filter collar over the filter cover. Tighten the filter collar finger-tight.
9. Start the engine and run it at increased rpm for one minute to purge air from the fuel lines.



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1. Filter Vent
2. Filter Vent Seal
3. Filter Collar
4. Filter Cover
5. Filter Cover Seal
6. Spring
7. Filter Element
8. Threaded Stud
9. Fuel Port
10. Drain

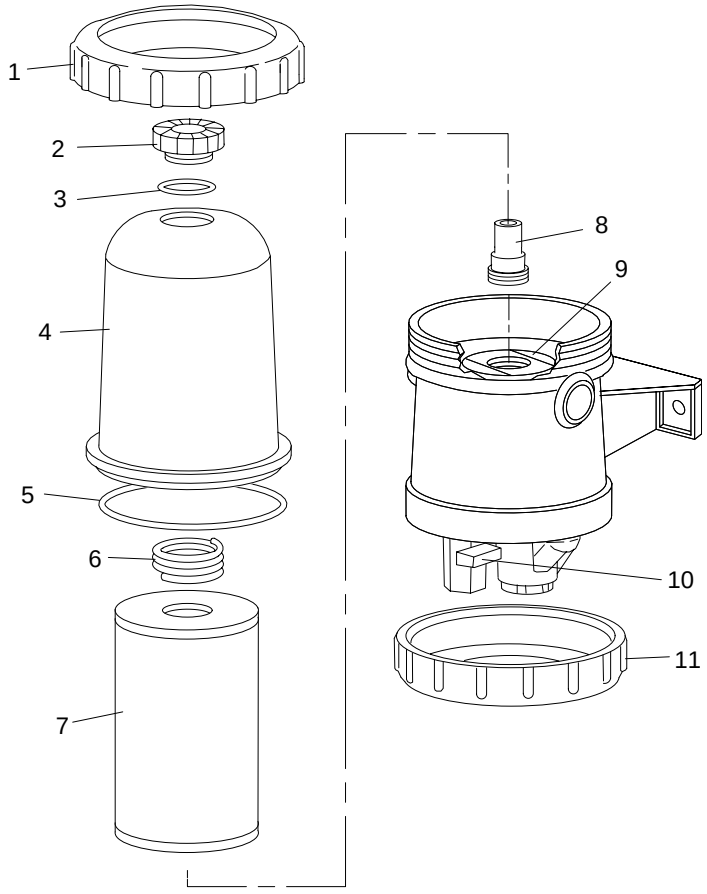
Fig. 13.2, Davco Model 232 and 233 Fuel/Water Separator

Emergency Starting With Jumper Cables

When using jumper cables, follow the instructions below.

⚠ WARNING

Batteries release explosive gas. Do not smoke when working around batteries. Put out all flames and remove all sources of sparks or intense heat in the vicinity of the battery. Do not allow the vehicles to touch each other. Do not lean over the batteries when making connections, and keep all other persons away from the batteries. Failure to follow these precautions could lead to severe personal injury as a result of an explosion or acid burns.



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1. Filter Collar
2. Filter Vent
3. Filter Vent Seal
4. Filter Cover
5. Filter Cover Seal
6. Spring
7. Filter Element
8. Threaded Stud
9. Fuel Port
10. Drain
11. Bottom Plate Collar

Fig. 13.3, Davco Model 382 Fuel/Water Separator

⚠ CAUTION

Make sure both starting systems have the same voltage outputs, and avoid making sparks. Otherwise the vehicle charging systems could be severely damaged. Also, do not attempt to charge isolated, deep-cycle batteries with jumper cables. Follow the battery manufacturer's instructions when charging deep-cycle batteries.

NOTE: On vehicles equipped with an optional jump-start post, attach the positive cable clamp to that post instead of to the battery.

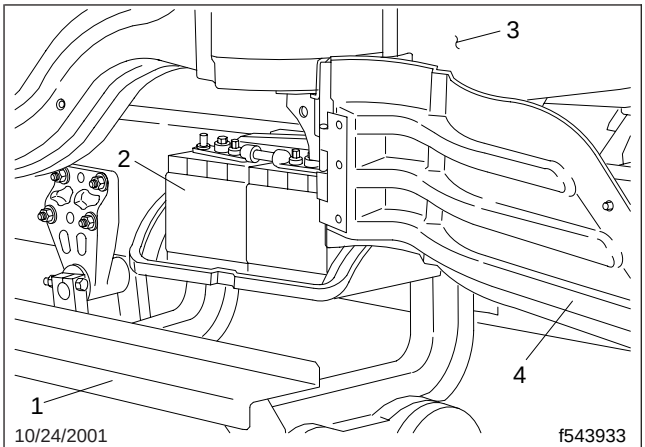
1. Apply the parking brakes and turn off the lights and all other electrical devices.
2. To gain access to the batteries, open the battery compartment. See **Fig. 13.4**. For detailed instructions, see **Chapter 2**.

⚠ CAUTION

Always connect the battery, jumper cables, and charger correctly (positive-to-positive and negative-to-negative). Connecting a charging device backwards (positive-to-negative) will blow fuses that power the bulkhead module (BHM) and

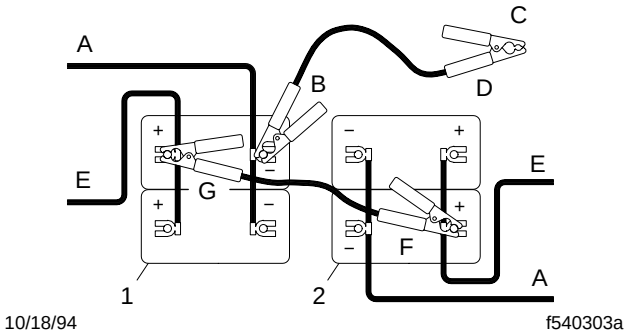
chassis module (CHM), and the devices they control will not work.

3. Connect an end of one jumper cable to the positive terminal of the booster battery (or jump-start post if equipped), and connect the other end of the cable to the positive terminal of the discharged battery (or jump-start post if equipped). See **Fig. 13.5**.



1. Top Step
2. Battery
3. Cab
4. Battery Access Door

Fig. 13.4, Battery Compartment, Open



A. To Ground
B. 3rd
C. To Frame (ground)
D. 4th
E. To Starter
F. 2nd
G. 1st
1. Booster Battery
2. Discharged Battery

Fig. 13.5, Jumper Connections

WARNING

Do the next step exactly as instructed and do not allow the clamps of one cable to touch the clamps of the other cable. Otherwise, a spark could occur near a battery, possibly resulting in severe personal injury from explosion and acid burns.

4. Connect one end of the second jumper cable to the negative terminal of the booster battery, and connect the other end of the cable to a ground at least 12 inches (300 mm) away from the batteries of the vehicle needing the start. The vehicle frame is usually a good ground. Do *not* connect the cable to or near the discharged batteries.

WARNING

On vehicles with Mercedes-Benz AGS transmissions, make sure the current gear indicator displays "N" before starting the vehicle. If the transmision starts in gear, it could cause an accident resulting in death, serious personal injury, or property damage.

5. Start the engine of the vehicle with the booster batteries, and let the engine run a few minutes to charge the batteries of the other vehicle.
6. Attempt to start the engine of the vehicle with the batteries receiving the charge. Do not operate the starter longer than 30 seconds, and wait at least two minutes between starting attempts to allow the starter to cool.
7. When the engine starts, let it idle a few minutes.

WARNING

Do the next step exactly as instructed and do not allow the clamps of one cable to touch the clamps of the other cable. Otherwise, a spark could occur near a battery, possibly resulting in severe personal injury from explosion and acid burns.

8. Disconnect the grounded cable from the frame or other non-battery location, then disconnect the other end of the cable.
9. Disconnect the remaining cable from the newly charged battery (or jump-start post if equipped) first, then disconnect the other end.

10. Close the battery compartment. For detailed instructions, see **Chapter 2**.

Towing

When it is necessary to tow the vehicle, make sure the instructions below are closely followed to prevent damage to the vehicle.

⚠ WARNING

Do not tow an unbraked vehicle if the combined weight of both vehicles is more than the sum of the gross axle weight ratings (GAWR) of the towing vehicle. Otherwise brake capacity will be inadequate, which could result in personal injury or death.

Front Towing Hookup

1. Disconnect the battery ground cables.

⚠ CAUTION

Failure to remove the axle shafts when towing the vehicle with the rear wheels on the ground could result in damage to the transmission and other parts.

2. Remove both drive axle shafts. On dual drive axles, if the vehicle is to be lifted and towed, remove only the rearmost drive axle shafts.

   On vehicles equipped with an air fairing, remove both the forward and rearmost drive axle shafts if there is insufficient towing clearance.

3. Cover the ends of the hubs with metal plates or plywood cut to fit the axle opening, and drilled to fit the axle shaft studs. This prevents lubricant from leaking out and will keep contaminants from getting into and damaging the wheel bearings and axle lubricant.

⚠ CAUTION

Failure to protect the frame rails from the chains could cause damage, leading to eventual frame failure.

4. On dual drive axles, if the vehicle is to be lifted and towed, chain the forward rear-axle assembly to the vehicle frame. Use protection to keep the chains from damaging the frame.

5. Remove the bumper end caps and chrome bumper (if equipped).

⚠ CAUTION

Do not pass a sling (for example, a rope or chain) from one tow hook to another to fasten for towing (see Fig. 13.6). Known as reeving, this practice is *not* permissible in most industrial applications of towing and hoisting. Reeving can overload the hooks and result in damage to the vehicle.

6. Attach the towing device. Due to the many variables that exist in towing, positioning the lifting and towing device is the sole responsibility of the towing-vehicle operator.

7. Lift the vehicle and secure the safety chains. If extra towing clearance is needed, remove the front wheels.

8. Connect the clearance lights, taillights, and signal lights. Connect any special towing lights required by local regulations.

⚠ WARNING

Failure to chock the tires or connect the tow truck's air brake system before releasing the spring parking brakes could allow the disabled vehicle to suddenly roll. This could cause property damage or personal injury.

9. Chock the tires on the disabled vehicle and connect the towing vehicle's air brake system to the vehicle being towed. Then, release the spring parking brakes and remove the chocks.

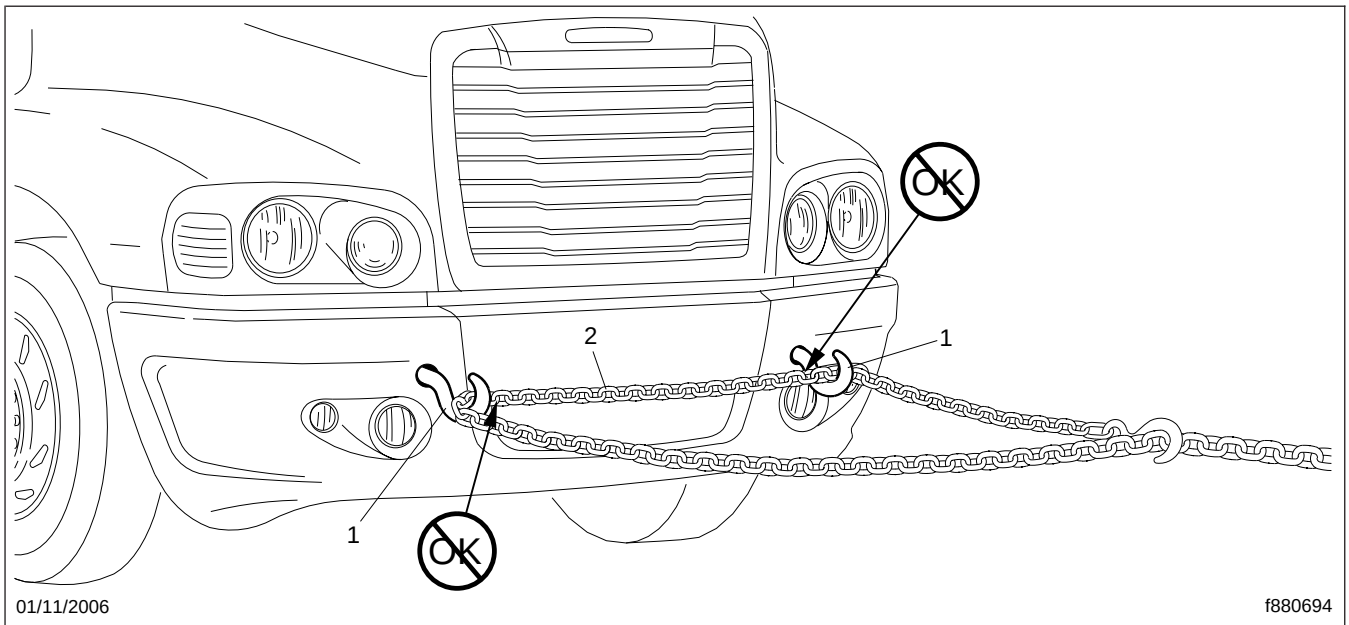
Rear Towing Hookup

⚠ CAUTION

Using a rear towing hookup on a vehicle equipped with a roof fairing could cause damage to the cab structure.

1. Place the front tires straight forward and secure the steering wheel in this position.

2. Disconnect the battery ground cables.



IMPORTANT: Do not reeve when towing.

1. Tow Hook
2. Chain

Fig. 13.6, Reeving

⚠ CAUTION

Failure to protect the frame rails from the chains could cause damage, leading to eventual frame failure.

3. On dual drive axles, using protection to keep the chains from damaging the vehicle frame, chain the forward-rear drive axle to the frame.
4. Attach the towing device. Due to the many variables that exist in towing, positioning the lifting and towing device is the sole responsibility of the towing-vehicle operator.
5. Lift the vehicle and secure the safety chains. If extra clearance is needed, remove the bumper extension if equipped.
6. Connect the clearance lights, taillights, and signal lights. Also connect any special towing lights required by local regulations.

Fire in the Cab

The incidence of fire in medium-duty trucks is rare, according to data from the National Highway Traffic Safety Administration. Federal Motor Vehicle Safety Standard #302 limits the flammability of specified materials used inside the cab, but despite this, most materials will burn. The cab of this vehicle contains urethane foam, which is of concern in this respect.

⚠ WARNING

Urethane foam is flammable! Do not allow any flames, sparks, or other heat sources such as cigarettes or light bulbs to contact urethane foam. Urethane foam in contact with such heat sources could cause a serious, rapid fire, which could result in death, severe burns, or gas poisoning, as well as damage to the vehicle.

In Case of a Cab Fire

As quickly as possible, bring the vehicle to a safe stop, apply the parking brake, turn off the ignition, and get out of the vehicle.

14

Headlight Aiming

Preliminary Checks 14.1
Checking Headlight Aim 14.1
Adjusting Headlight Aim 14.2

Headlight Aiming

Preliminary Checks

Before checking or adjusting the headlight aim, do the following:

- Remove large amounts of mud or ice from the underside of the fenders.
- Check the springs for sagging or broken leaves.
- Check the suspension for proper functioning of the leveling mechanism. On cabs with air suspensions, make sure that the height is properly adjusted.
- Check for damage to the hood and hinge assembly. Repair as necessary.
- With the vehicle unloaded, check that the tires are inflated to the recommended air pressure.
- Clean the headlight lenses. Clean by hand only, using a flannel cloth with mild, non-caustic soap or detergent, and water.

⚠ CAUTION

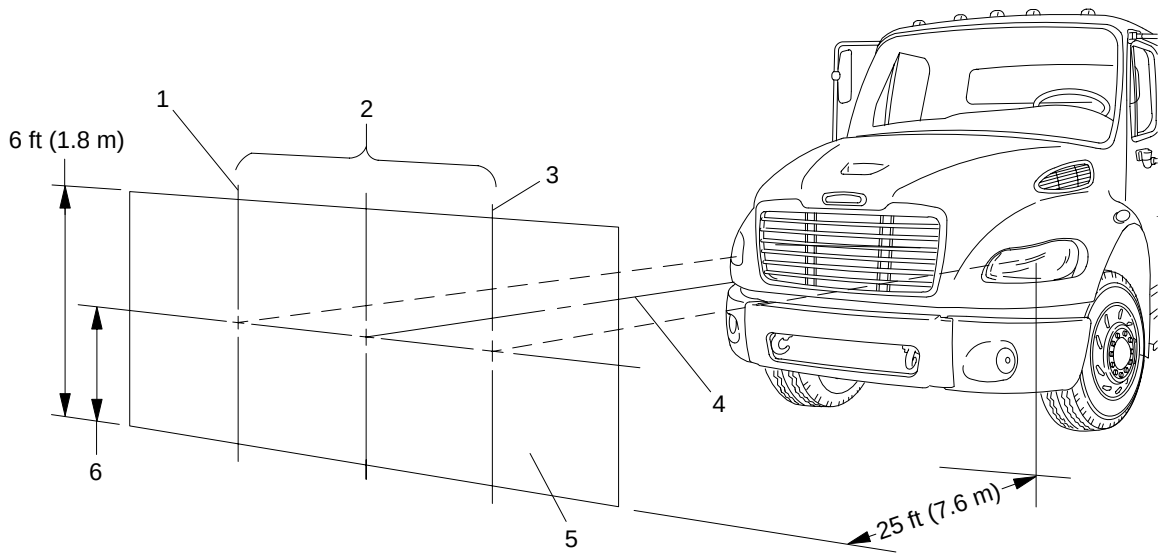
Do not use a power buffer, paper towels, chemical solvents, or abrasive cleaners on the headlight lens, all of which can remove the UV coating from the surface, and result in yellowing of the lens.

Checking Headlight Aim

1. Park the vehicle on a level surface 25 ft (7.6 m) from a screen or wall that can be used for aiming the headlights. Shut down the engine, apply the parking brake, and chock the front tires. See **Fig. 14.1**.

NOTE: The low-beam headlight is the top bulb in the dual-beam assembly.

2. On each headlight, find the bulb center. See **Fig. 14.2**.
3. Measure the distance from the ground to the center of each low-beam bulb. Note those distances.



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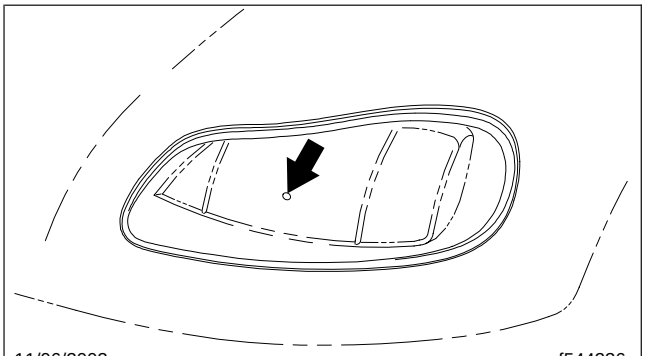
1. Vertical Centerline of Right Headlight
2. Distance Between Headlights
3. Vertical Centerline of Left Headlight
4. Projected Vehicle Centerline
5. Screen or Wall
6. Height of Lamp Centers

Fig. 14.1, Headlight Aiming Screen or Wall



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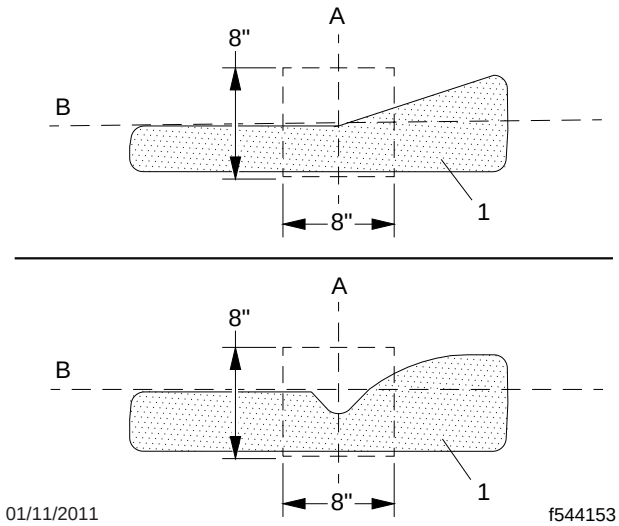
Measure beam height from the ground to the small dot roughly in the center of the headlight lens.

Fig. 14.2, Headlight Beam Height Adjusting Dot

4. On the screen or wall 25 ft (7.6 m) away, make the appropriate markings directly across from each headlight and at the same height as measured for the headlight.
5. Turn on the headlights to the low-beam setting. See **Fig. 14.3** for the ideal and acceptable patterns for both headlights.



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NOTE: The top view shows the ideal beam pattern; the bottom view shows an acceptable standard.

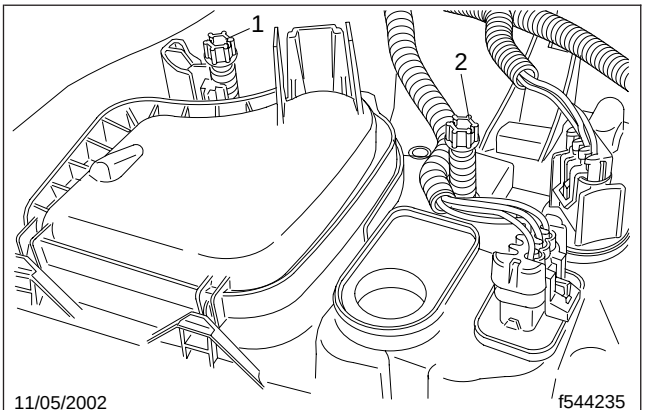
A. Vertical Centerline B. Horizontal Centerline
1. Bright Area

Fig. 14.3, Headlight Beam Pattern

- If either or both headlights do not aim into the inner edges of the centerline, follow the adjusting procedure below.
- If both headlights come close to the inside of each headlight centerline (as shown), no further work is needed. Turn off the headlights and remove the chocks from the front tires.

Adjusting Headlight Aim

1. Lift the flap over the rear end of the headlight bucket to expose the two plastic adjusting knobs on each headlight. See **Fig. 14.4**.



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NOTE: The right-hand side headlight bucket is shown. The left-hand side is opposite.

1. Inboard Adjusting Knob
2. Outboard Adjusting Knob

Fig. 14.4, Headlight Adjusting Knobs

NOTE: Horizontal aim should not be adjusted in the field.

2. With the vehicle parked 25 ft (7.6 m) from the screen or wall, put the headlights on low beams, and turn both adjusting knobs the same amount, as needed to adjust the lights until the beam pattern meets the acceptable standard. Turn the knobs clockwise to raise the beam and counterclockwise to lower it.

NOTE: Blocking off each light is not necessary, but it can help to present a clearer beam pattern.

3. Remove the chocks from the front tires.

15

Hybrid Electric Vehicle

Hybrid Electric Vehicle (HEV) Overview 15.1
Safety Precautions (HEV) 15.2
Starting, and Engine Shutdown (HEV) 15.2
Hybrid System Fault Lamps (HEV) 15.2
Emergencies (HEV) 15.3
Jumpstarting (HEV) 15.3
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Hybrid Electric Vehicle (HEV) Overview

A hybrid electric vehicle (HEV) has both a diesel engine and an electric motor. Engine torque is augmented with electrical torque. The electric motor is powered by batteries, which are charged by regenerative braking and, on vehicles equipped with the ePTO option, the diesel engine.

The batteries cannot move the vehicle for long distances at highway speeds. In the event of a diesel engine failure, drive the vehicle to a safe location as quickly as possible.

Eaton Corporation developed and supplies the hybrid electric system for Freightliner Trucks. The primary system components are the hybrid drive unit (or "HDU", which includes the electric generator/motor and automated transmission), power electronics carrier (PEC), and the motor inverter/controller. Electric power take-off (ePTO) and auxiliary power generator (APG) components are optional on the HEV system.

Freightliner Trucks designed the stand-alone liquid cooling system required to support the operation of Eaton's HEV system. Its primary system components are the electric water pump, reservoir/expansion tank, radiator, electric radiator fan, and coolant plumbing.

Body builders will develop the components for the PTO, the PTO plumbing, and a safety switch to prevent the diesel engine from starting when the hood is open.

Regenerative Braking

Regenerative braking reduces vehicle speed by converting some of the vehicle's kinetic energy into electric energy to charge the hybrid system's batteries. When the accelerator pedal is at idle while coasting, or the service brake is depressed to slow the vehicle, the hybrid system charges the batteries.

The regeneration will feel as if the brake is being lightly applied when you remove your foot from the accelerator pedal. The full power of the service brake is always available to the driver, and regenerative braking is automatically shut off during an ABS (antilock brake) event.

The Eaton Hybrid Control Unit will automatically shut off regenerative braking when the batteries are fully charged.

High-Voltage Safety Features

The HEV has high-voltage cables and a service switch on the PEC.

High-voltage cables are covered in orange insulation and conduit. Each high-voltage component is tagged with a warning or danger label.

IMPORTANT: The service switch on the PEC should only be used for an emergency shutdown, or when the service manual or troubleshooting guide calls for work on the high-voltage system. The service manual and troubleshooting guide for the hybrid electric system are available from **www.roadranger.com**.

The red service switch is located next to the high-voltage cable connections at one end of the PEC. Pushing in the red service switch will shut down the engine. The hybrid system will be disabled, and the high-voltage batteries in the PEC, though still live, are isolated in the PEC.

NOTE: The PEC may be mounted in an area with limited access.

For information on emergency shutdowns, see "Emergencies" in this chapter.

Cooling System

The HEV requires a liquid cooling system for the HDU, inverter, DC/DC Converter (if ePTO equipped), and APG (if equipped). The HEV's cooling system is separate from the engine cooling system.

For coolant, use a mixture of 50 percent ethylene glycol and 50 percent water.

Electric Power Take-Off (ePTO)

The Electric Power Take-Off (ePTO) option provides standard hydraulic functions without continuous diesel engine operation. The PTO drive power is provided by the hybrid motor and hybrid batteries. When the hybrid batteries deplete, the diesel engine automatically starts to recharge them and provide PTO drive power. Once the batteries are fully charged, the engine shuts down automatically. Vehicles with the ePTO option are designed with a safety switch to ensure the diesel engine does not start when the hood is open.

A DC/DC converter is required for ePTO applications to convert high-voltage DC to 12-volt DC.

NOTE: To maintain a power supply from the vehicle's low-voltage batteries, the alternator charges them when the vehicle is being driven.

Safety Precautions (HEV)

The HEV has high-voltage components, including 340-volt DC batteries and a 500-volt AC motor. Never cut high-voltage cables or connectors. Do not paint high-voltage cables.

Avoid direct pressure wash on high-voltage connections (PEC, DC/DC Converter) and the air intake and exhaust on the PEC.

Starting, and Engine Shutdown (HEV)

The Cranking System

The primary engine starter is the electric motor in the HDU, which cranks the engine very quickly. The back-up cranking system is the standard 12-volt starter on the engine. If the hybrid system is offline or the hybrid batteries are insufficiently charged, the vehicle will automatically use the 12-volt cranking system to start the engine.

Starting

1. Set the parking brake.
2. Place the key in the ignition, and turn it clockwise to the ON position to initiate power to the hybrid system.

   Wait for the gauges on the instrument panel to complete two sweeps (one from left to right, and one from right to left) and return to their normal ranges.
3. Ensure the transmission is in neutral. The gear display should display a solid "N".

⚠ WARNING

Never start the engine unless the transmission is in neutral and the brake is applied. Accidental movement of the vehicle could result in property damage, personal injury, or death.

4. Turn the key clockwise to the START position. The engine will crank after a brief delay. As soon as the engine starts, release the key, allowing it to return to the ON position. The engine will continue to run with the key in the ON position.
5. Apply the service brake, then release the parking brake.
6. With the service brake applied, press the desired mode on the shift control to put the vehicle into gear.
7. Slowly release the service brake.

NOTE: The vehicle may be powered by the electric motor or the diesel engine, depending on battery charge and the demand for driveline torque. If the electric motor alone is powering the driveline, the diesel engine will stay at idle.

Engine Shutdown

1. Place the transmission in neutral by selecting N on the shift control.

IMPORTANT: The transmission must be in neutral for proper shutdown.

2. Set the parking brake.
3. Turn the key counterclockwise to the OFF position.

NOTE: Intermittent noises such as clicking and transmission shifting may be audible from the transmission while it completes a self-test and shutdown.

Hybrid System Fault Lamps (HEV)

There are two lamps on the dashboard that indicate a hybrid system fault is active — the red STOP HYBRID lamp and the amber CHECK HYBRID lamp. See **Fig. 15.1**. When the red STOP HYBRID lamp is illuminated, do not drive the vehicle; have it towed to a Freightliner dealer or an authorized service center for repairs. When the amber CHECK HYBRID lamp is illuminated, the vehicle can still be driven, though it may operate without the assistance of the hybrid electrical system.

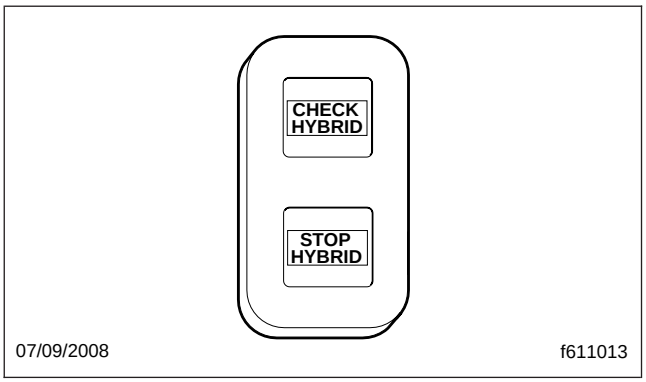

Fig. 15.1, Hybrid System Fault Lamps

Emergencies (HEV)

Emergency Shutdown

WARNING

After disabling the vehicle, power is maintained in the high-voltage electrical system for up to five minutes. Unprotected contact with any "live" high voltage components can cause serious injury or even death.

There are two options for performing an emergency shutdown. The preferred method is to turn off the ignition key. The other option is to disconnect the low-voltage (12-volt) vehicle batteries. In either case, the engine will shut down, dash lights will shut down, the hybrid electrical system will shut down, and the high-voltage batteries in the Power Electronics Carrier (PEC) will remain "live" but isolated in the PEC.

NOTE: If the service switch on the PEC is accessible, it may be pushed in to shut down the hybrid electrical system and isolate the "live" HEV batteries in the PEC.

In Case of an Accident or Fire

If the HEV becomes involved in an accident or fire, be aware of the following:

- Use CO2 or dry chemical extinguishers. The batteries in the PEC are lithium ion.
- Do not cut into high-voltage cables. The high-voltage wiring is covered in orange insulation or convoluted tubing.
- Do not cut into or open the PEC.
- Do not cut into or open the DC/DC converter.
- Do not cut into or open the inverter.

If it is necessary to remove occupants using cutting equipment, avoid high-voltage cables and the PEC.

Jumpstarting (HEV)

Jumpstarting vehicles equipped with the Eaton® Hybrid System is identical to Non-Hybrid vehicles, which use the vehicle 12-volt battery system.

Towing (HEV)

When towing the vehicle, the output shaft of the transmission must not be allowed to spin or turn. If the vehicle is towed with the drive wheels still in contact with the road surface, the vehicle axle shafts or driveline must be removed or disconnected. See "Towing" in **Chapter 13**.

16

Natural Gas Vehicle

General Information 16.1
Safety Precautions 16.1
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Gas Detection System 16.5
Engine Starting 16.9
Major Repair and Replacement of Parts 16.10

Natural Gas Vehicle

General Information

The Business Class® M2 can be equipped with a compressed natural gas (CNG) fuel system, or a liquefied natural gas (LNG) fuel system. CNG is made by compressing natural gas to less than 1% of its volume at standard atmospheric pressure. LNG is created by condensing natural gas into a liquid by cooling it to approximately -259°F (-162°C).

When vaporized at ambient temperatures, natural gas is less dense than air, and it rises and disperses. However, LNG is intially heavier than air due to its cryogenic temperature. When released in large amounts, it may drop or pool on the ground before it's temperature rises and the LNG vaporizes. Cold atmospheric conditions may prevent natural gas from dispersing quickly when released in large amounts.

Natural gas is nontoxic, but it can cause asphyxiation if present in very large concentrations.

CNG often contains an odor-producing chemical, while LNG does not have any odor. Users of natural-gas-fueled vehicles should never expect to detect natural gas leaks by scent.

For natural gas to burn, it must first vaporize, then mix with air in the proper proportions (flammable range is 5 to 15% by volume in air), and then be ignited.

A typical natural gas fuel system consists of:

- Fuel supply cylinders that store compressed gas at high pressure (CNG), or a tank that stores liquefied gas at an extremely low temperature (LNG).
- A vaporizor or heat exchanging device that changes LNG to gaseous form (LNG fuel systems only).
- Pressure relief and manual fuel shutoff valves.
- A filling connection with a check valve that prevents the gas from flowing back out of the fuel filling line.
- High-pressure and low-pressure fuel filters.
- A pressure control regulator that reduces the high fuel tank or cylinder pressure to the lower pressure needed for the engine.
- A fuel contents gauge that indicates the fuel supply in the tank or cylinders.

Safety Precautions

⚠ DANGER

Natural gas is highly flammable. Failure to observe the following safety precautions could lead to the ignition of the natural gas, which could cause serious bodily injury or death.

Follow these safety precautions when operating or repairing a natural gas vehicle.

- Do not start the engine if a natural gas leak is detected.
- Do not transfer CNG from one vehicle to another, as a buildup of static electricity could cause a spark and ignite the fuel.
- Avoid open flames or sparks near a natural gas vehicle.
- Cover eyes and exposed skin when working on a natural gas fuel system or fueling a natural gas vehicle.
- Permit no smoking or other ignition sources within thirty feet of a natural gas vehicle.
- Have CO_2 fire extinguishers (ABC minimum) located in a highly visible and easily accessible location.
- Always purge the fuel lines before performing maintenance or repairs on a natural gas fuel system. To purge the lines, close the manual fuel shutoff valve, and start the engine. Let the vehicle idle until the fuel lines are empty and the engine stops.
- Always use a natural gas detector to test the system for leaks, whether an odor is present or not. Routinely inspect the fuel filtering and regulating mechanisms, and the fuel lines. A bubble solution can be used to pinpoint the exact location of leaks.
- Always tighten fasteners and fuel connections to the required torque specification. Overtightening or undertightening could cause leaks.
- Close the fuel shutoff valve(s) before performing maintenance and repairs.
- Do not store a natural gas vehicle indoors for any extended period of time. Do not bring a natural gas vehicle inside indoors unless the

workshop is equipped with a methane detection and ventilation system.

Fuel Tank Filling Procedures

CNG Vehicle Fueling

CNG is moved from the fuel station storage tanks to the vehicle cylinders through a metered dispenser. During fueling, as pressure inside of the vehicle cylinders increases, so does the temperature. The dispenser shuts off when it determines the CNG cylinders are full.

CNG fuel cylinders cannot be filled to their full capacity of 3600 psi (24 800 kPa) in cooler weather. Since temperature change causes gas to expand and contract, less pressure in the cylinders on a cold day is equal to the same amount of gas at a higher pressure on a warm day. The fuel station dispenser has a temperature-pressure compensating device, which accounts for ambient temperature during fueling. See **Table 16.1** for approximate full cylinder pressures at various temperatures.

CNG Temperature/Pressure Compensation Values		
Temperature: °F (°C)	Fill Station Pressure Set Point	
	3000 psi (20 684 kPa) Set Point	3600 psi (24 821 kPa) Set Point
100 (37.8)	3415 (23 546)	4086 (28 172)
90 (32.2)	3276 (22 587)	3909 (26 952)
80 (26.7)	3138 (21 636)	3754 (25 883)
70 (21.1)	3000 (20 684)	3600 (24 821)
60 (15.6)	2861 (19 726)	3445 (23 752)
50 (10)	2723 (18 774)	3288 (22 670)
40 (4.4)	2584 (17 816)	3131 (21 587)
30 (-1.1)	2446 (16 865)	2973 (20 498)
20 (-6.7)	2307 (15 906)	2814 (19 402)
10 (-12.2)	2169 (14 955)	2655 (18 306)
0 (-17.8)	2031 (14 003)	2495 (17 202)
-10 (-23.3)	1893 (13 052)	2336 (16 106)
-20 (-28.9)	1755 (12 100)	2180 (15 031)
-30 (34.4)	1616 (11 142)	2024 (13 955)
-40 (-40)	1477 (10 184)	1868 (12 879)

Table 16.1, CNG Temperature/Pressure Compensation Values

Use the following steps to fuel a CNG vehicle.

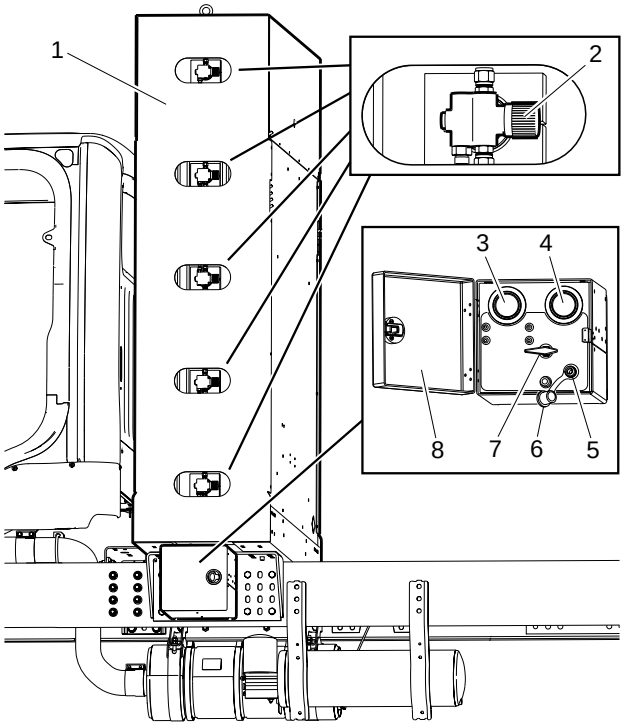
1. Shut down the engine and apply the parking brake.

IMPORTANT: Close all windows and doors during the fueling process. Keeping windows and doors closed allows for easier leak detection inside the cab after fueling.

⚠ WARNING

Natural gas fuel tanks, lines, and valves are always pressurized. Always observe safety precautions. Failure to do so could lead to loss of control over a filling hose or to ignition of the natural gas, which could cause serious bodily injury, death, or severe property damage.

2. Ensure all fuel cylinder shutoff valves are open. See **Fig. 16.1**.



1. Fuel Cylinder Storage Box
2. Fuel Cylinder Shutoff Valves (qty 5)
3. High-Pressure Gauge
4. Low-Pressure Gauge
5. Fuel Fill Port
6. Dust Cap
7. Manual Shutoff Valve
8. Fuel Panel Access Door

Fig. 16.1, CNG Fuel Cylinder Storage Box (5-cylinder system shown)

3. Ensure the vehicle fuel system main shutoff valve is open.
4. Open the CNG fuel panel access door and remove the dust cap from the vehicle fuel fill port.
5. Ensure the O-ring is present inside the fuel fill port. If the O-ring has been dislodged or is missing, the station dispensing nozzle will not connect securely to the fill port.
6. Turn the selector knob on the service pump to the VENT position, if equipped.
7. Connect the quick coupling on the dispensing nozzle securely to the vehicle fuel fill port.
8. Turn the selector knob on the service pump to the FILL position, if equipped.

IMPORTANT: If at any time the service pump or vehicle begins to vent CNG uncontrollably, notify a station attendant or activate the service station emergency shut-off switch to cease the flow of CNG.

9. Switch on the service pump. A slight hissing noise may be heard as the fuel cylinders fill.
10. Watch the pressure gauge on the service pump. When the gauge reads approximately 3600 psi (24 800 kPa), or when the fill pressure stops climbing, the CNG cylinders are full. The service pump will shut itself down automatically. See **Table 16.1** for pressure compensation values based on ambient temperatures.
11. Move the selector knob on the service pump to the VENT position, if equipped. A short hiss will be heard as a small amount of natural gas is vented into the hose.

⚠ WARNING

Do not attempt to remove the fill station nozzle from the tank fill fitting until venting of pressure is noted. If no venting occurs, ask for assistance from the station attendant. Removing an unvented coupling could result in an uncontrolled hose, which could lead to property damage or personal injury.

12. Remove the station dispensing nozzle from the vehicle fill port.
13. Install the dust cap on the vehicle fuel fill port and close the fuel panel access door.

LNG Vehicle Fueling

The LNG fuel tank is designed to be filled from any LNG fuel source that has a 100 micron or finer fuel filter and a fuel delivery pressure between 120 and 225 psi (827 and 1551 kPa).

The LNG fuel tank is designed to be top-filled through a single hose with no vent return. As cold LNG is sprayed into the vapor space of the tank, the cold liquid condenses the vapor and creates space for itself inside the tank, eliminating any need to vent during the filling process.

The LNG tank is equipped with a small internal ullage tank for vapor space, which allows for fuel expansion and increases vehicle standby time. When an LNG tank is full, fuel can continue to flow into the ullage tank. However, if the ullage tank is completely filled during fueling, standby time will be reduced to zero and the primary relief valve will open almost immediately after fueling, allowing excess LNG vapor to escape. If fueling is stopped when the ullage tank is empty (i.e., the fuel tank has sufficient vapor space to accommodate fuel expansion due to temperature increase), the vehicle will have approximately one week of standby time before venting will occur.

Use the following steps to fuel an LNG vehicle.

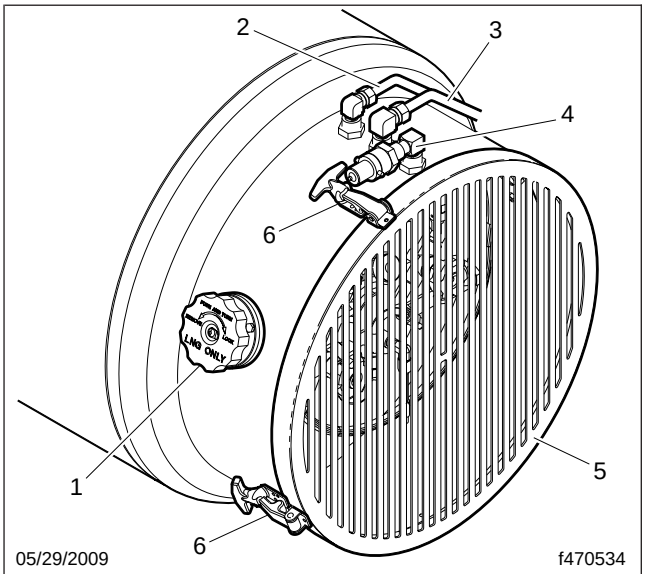
1. Shut down the engine and apply the parking brake.

IMPORTANT: Close all windows and doors during the fueling process. Keeping windows and doors closed allows for easier leak detection inside the cab after fueling.

⚠ WARNING

Liquefied natural gas is a cryogenic liquid stored at approximately -259°F (-162°C). Cryogenic burns can be caused by coming into contact with the pressurized liquid stream, or by coming into contact with fuel system components that have been cooled to cryogenic temperatures. Always wear gloves and a face shield, and cover exposed skin when fueling.

2. Remove the fuel fill fitting dust cap. See **Fig. 16.2**.



1. Fuel Fill Fitting
2. Fuel Outlet Line
3. Primary Relief Vent Line
4. Fill Vent Fitting
5. Shroud Cover
6. Shroud Cover Latches

Fig. 16.2, LNG Fuel Tank

3. Using compressed air, remove any dirt, debris, or water that may have collected in the fuel fill fitting and the station dispensing nozzle. Contaminants in the fuel system can cause drivability problems.

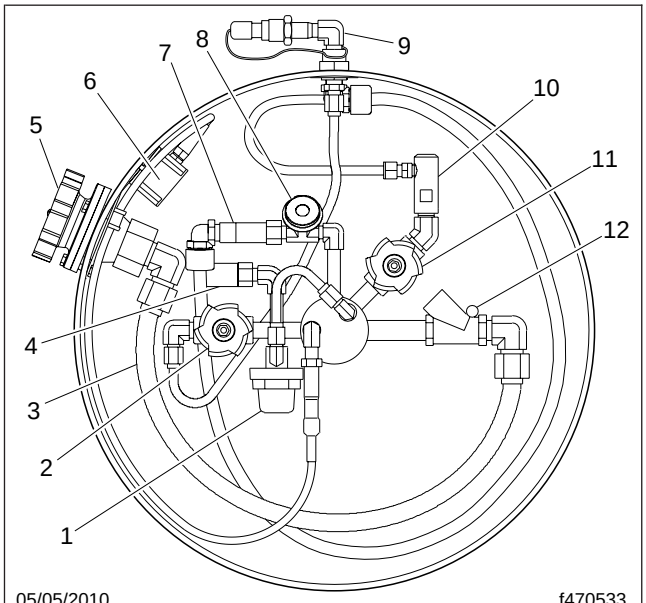
⚠ WARNING

Natural gas fuel tanks, lines, and valves are always pressurized. Always observe safety precautions. Failure to do so could lead to loss of control over a filling hose or to ignition of the natural gas, which could cause serious bodily injury, death, or severe property damage.

4. Connect the station fueling nozzle to the tank fuel fill fitting.
5. Connect an electrical ground clamp and cable to the fuel tank.

IMPORTANT: An LNG tank which is first installed, or is on a vehicle that has not been operated in approximately ten days, is considered to be a hot tank. When fueling a hot tank, LNG entering the tank will immediately vaporize, causing tank pressure to spike above 250 psi (1724 kPa) and automatically shutting down the station fuel pump. To prevent the pump from shutting down, connect a vent line to the fill vent fitting on the LNG tank to capture escaping vapor, then open the shroud cover and open the vapor shutoff valve (**Fig. 16.3**, Item 2).

6. Open the station's fill valve, if equipped, and start fueling. Monitor the flow or line pressure as filling progresses. When filling begins, line pressure will spike quickly until the vehicle tank cools down. The flow and pressure will then remain stable during the remainder of the filling procedure.



1. Pressure Control Regulator
2. Vapor Shutoff Valve
3. Fuel Fill Hose
4. Secondary Relief Valve (red cap)
5. Fuel Fill Fitting
6. Fuel Level Sender Box
7. Primary Relief Valve
8. Tank Pressure Gauge
9. Fill Vent Fitting
10. Excess Flow Valve
11. Fuel Shutoff Valve (liquid)
12. Fill Check Valve

Fig. 16.3, LNG Fuel Tank Plumbing Components

IMPORTANT: When fueling a hot tank, initially put 5 to 10 gallons (19 to 37 liters) of LNG in the tank and manually stop the fueling process. Drive the vehicle for 15 to 20 minutes to cool

the tank and reduce tank pressure, then continue fueling the tank to full.

7. When the tank is full, the line pressure will rapidly spike and the flow rate will fall. When a pressure rise or flow rate drop is observed, close the station's fill valve, if equipped.

NOTE: Do not over-fill an LNG tank. If the ullage tank is completely filled during fueling, tank standby time will be reduced to zero and the primary relief valve will open almost immediately after fueling.

8. Disconnect the station hose from the tank fuel fill fitting.
9. Disconnect the electrical ground clamp and cable from the fuel tank.
10. Install the dust cap on the tank fuel fill fitting.

Gas Detection System

A gas detection system is used in all Daimler Trucks natural-gas-fueled vehicles. This system has a sensor in the engine compartment and one in the cab, both situated in high areas to detect natural gas buildup as a result of leaks.

The AMGaDS III Plus is a natural gas detection system. This device is meant to serve as a supplemental warning only. It is not intended to replace standard safety practices that should be conducted around flammable gases.

IMPORTANT: To function properly, the gas detection system must be powered at all times. The gas detection system is directly powered by the batteries, and can only be powered off by disconnecting the batteries.When servicing a natural-gas-fueled vehicle, disconnect the batteries only when necessary, and do not leave the batteries disconnected for extended periods of time.

The lower flammability limit (LFL) is the smallest amount of the gas that supports a flame when mixed with oxygen and ignited. Zero percent (0%) LFL indicates a gas-free atmosphere. One hundred percent (100%) LFL indicates that gas concentration has reached its lower flammability limit (5% gas in air by volume). The red warning light and audible alarm located in the overhead console activate when a sensor detects gas fumes in concentrations above 50% LFL, and should allow ample time to utilize safety procedures. However, individuals with special needs should review the system with a professional safety engineer.

Alarm Procedure

Before operating the vehicle, the driver must be familiar with the procedures as shown on the interior sticker on the overhead panel (**Fig. 16.4**) and the exterior sticker on the door (**Fig. 16.5**).

Fig. 16.4, Interior Warning Sticker

IMPORTANT: If an audible alarm activates, do not operate any electrical switch, including lights. Avoid causing sparks and stay away from arcing switches and equipment. Do not use a telephone, including cellular phones or any types of portable communication or electronic devices that have a battery.

If the vehicle is in motion when the audible alarm activates, bring it to a safe stop, shut down the engine, and exit the vehicle. *Do not open the hood.*

If outside the vehicle when the audible alarm activates, *do not open the cab door or hood.*

In the event of an audible alarm, immediately follow these procedures, as allowed by conditions:

1. Immediately shut off all engines. Extinguish any cigarettes, pilot lights, flames, or other sources of ignition in the area and adjacent areas.

Fig. 16.5, Exterior Warning Sticker

2. Manually close all fuel shutoff valves, including those on the LNG tank or CNG cylinders.
3. If the vehicle is indoors (as in a service shop), immediately open windows and doors to provide extra ventilation to the area. Do not start the engine or any other type of equipment until the gas leak is corrected and the area cleared of natural gas.
4. Evacuate the area.
5. Check the fuel lines, LNG tank/CNG cylinders, and fittings to locate the leak. After the area is cleared of natural gas and the alarm is no longer active, have the vehicle inspected by a qualified technician.

IMPORTANT: Do not consider the area clear until all alarm indicators are off, and the alarm panel light returns to green.

Sensors

Gas detection sensors are located on the cab overhead console and in the engine compartment on the frontwall. The sensors are located in high areas, where rising gas vapors will pass by or accumulate.

If the system detects that one of the sensors has been disconnected or has malfunctioned, the sensor fault light for that zone will illuminate. A failed sensor may trigger and lock on an alarm. If a fault condition or locked alarm continues after the sensor's connection and wiring integrity has been verified, replace the sensor.

The sensors are sensitive to all hydrocarbon vapors. An alarm may be triggered by the use of chemicals such as cleaners, paint, polish, lacquer, gasoline, silicone, silicone spray, or other harsh chemicals. The sensors will also detect hydrogen fumes from an overcharged battery. If a sensor sends an alarm, but no gas fumes are present, check for recent use of chemicals or a battery charger.

NOTICE

Silicone-based chemicals and cleaners will permanently disable the sensors. When cleaning the vehicle, cover the sensors with a plastic covering. Keep the sensors covered until the area has been cleared of any cleaning fumes.

Harsh chemicals and extremely high temperatures may damage the sensor.

Puncture of or damage to the seal located inside the sensor housing will significantly shorten the sensor life.

Frequent exposure to high concentrations of gas will accelerate sensor deterioration.

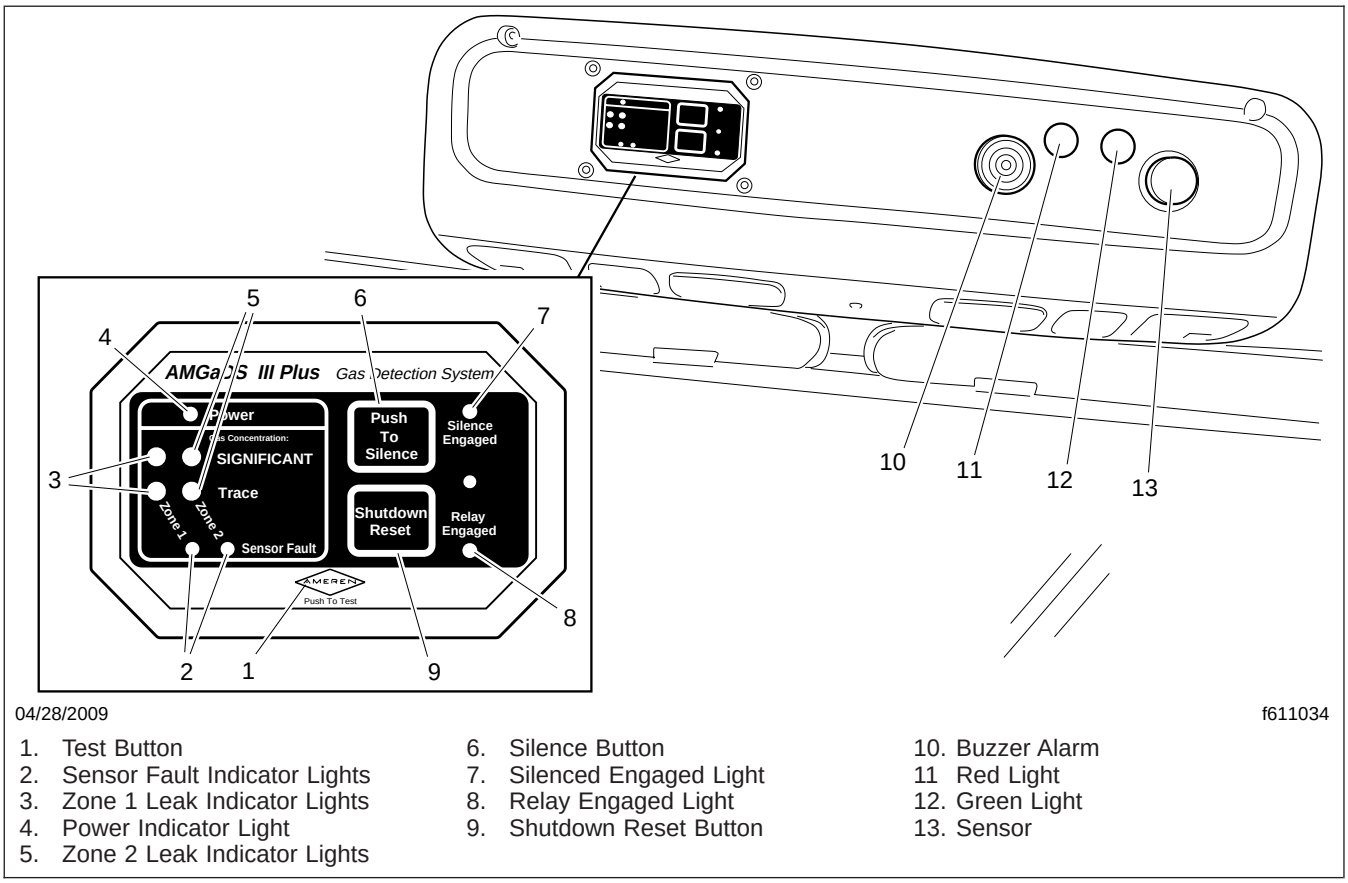
Overhead Console

The overhead console consists of an alarm panel on the right side and the control module on the left side.

The alarm panel has a green light, a red light, a buzzer, and a sensor. See **Fig. 16.6**. It is located within view from outside of the vehicle. The large green light is continuously illuminated during normal operating conditions.

Before entering the vehicle, always verify that the green light is illuminated. If the green light is not illuminated, do not enter the vehicle. Complete the alarm procedure previously outlined.

The alarm panel meets the California Highway Patrol Title 13-2008 and NFPA 52 2010 requirements. All



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1. Test Button
2. Sensor Fault Indicator Lights
3. Zone 1 Leak Indicator Lights
4. Power Indicator Light
5. Zone 2 Leak Indicator Lights
6. Silence Button
7. Silenced Engaged Light
8. Relay Engaged Light
9. Shutdown Reset Button
10. Buzzer Alarm
11 Red Light
12. Green Light
13. Sensor

Fig. 16.6, AMGaDS III Plus Overhead Console

drivers and technicians using it should be trained regarding the red and green lights, and the audible warning.

The control module, located on the left side of the overhead console, contains the status lights and control buttons for the system. The areas that the sensors monitor are defined as Zone 1 (cab) and Zone 2 (engine compartment). The control module has lights assigned to each zone that will illuminate if a sensor detects a trace level leak (between 20% and 30% LFL), a significant level leak (above 50% LFL), or if a sensor is disconnected or malfunctioning.

- Trace Level: If either sensor detects gas fumes at a concentration greater than 20% to 30% LFL (1% gas in air by volume), the amber light next to the *Trace* indicator for that zone will flash. There is no buzzer alarm for a trace level detection, and the large green light on the alarm panel will remain illuminated.
- Significant Level: If either sensor detects gas fumes at a concentration greater than 50% to 60% LFL (2.5% gas in air by volume), the small red light next to the *SIGNIFICANT* indicator for that zone will flash. After approximately 15 seconds, the large green light on the alarm panel will switch off, the red light will illuminate, and the buzzer will sound. All alarm indicators will remain on as long as fumes are detected.
- Sensor Fault: If the system detects that either of the sensors has been disconnected or has malfunctioned, an amber light next to the *Sensor Fault* indicator for that zone will illuminate.

The control module also has buttons used to test or reset the the control module after an alarm. Red lights next to each button indicate when they are engaged.

- Shutdown Reset: If an alarm has been activated and the *Relay Engaged* light is illuminated, the *Shutdown Reset* button will reset the internal relay. Press the *Shutdown Reset* button only after the gas has cleared, the buzzer has turned off, and the alarm panel light has returned to green.
- Push To Silence: If an alarm has been activated, the *Push To Silence* button will silence the buzzer.

See **Table 16.2** for the functions of all lights and buttons on the overhead console.

Testing

Daimler Trucks North America strongly recommends that all operators follow California Code of Regulations (CCR) inspection requirements, regardless of where the vehicle is operated. Per Title 13 CCR § 935 (2), gas detection systems should be tested three times per calendar year at equal intervals. The testing procedure should simulate the same operating environment in which the vehicle is used, with the same gaseous fuel.

Test results validating the performance of the gas detection system within the parameters established by the component manufacturer and NFPA 52 2010 should be maintained as a permanent part of the vehicle service records. Use of alcohol, propane, and other harsh liquids or gases are not acceptable methods for testing.

Always test the system and sensors after any component has been replaced, or if the vehicle has been involved in an accident or fire. Ensure that the gas detection system is wired directly to the battery.

It is recommended that the highest level of safety validation be utilized if there are multiple validation requirements in the state or locality where the vehicle is operated or domiciled.

Control Module Functions

Item	Display	Function	Action Required
Green Power Light	Illuminated	System is on.	None required.
	Unlit	Detection system is not functioning.	Ensure the batteries are connected and replace any blown fuses. If the gas detection system is still not functioning, replace the system immediately.
SIGNIFICANT Gas Concentration Lights	Red (illuminated)	Dangerous gas concentration detected.	Suspend vehicle operation immediately and follow alarm procedures.
Trace Gas Concentration Lights	Amber (flashing)	Minor gas concentration detected.	Use caution and monitor the system.
Sensor Fault Lights	Off	Sensor is functioning properly.	None required.
	On	Sensor has malfunctioned.	Replace the sensor immediately.
Shutdown Reset Button	—	Resets the system after an alarm activation.	Press to reset the system only after the gas has cleared, the buzzer has turned off, and the alarm panel light has returned to green.
Relay Engaged Light	On	Relay is engaged and test or alarm is being cleared.	Press the *Shutdown Reset* button.
	Off	Normal condition.	None required.
Test Button	—	Tests the overhead console operation and circuitry.	Press and hold for one minute to to activate a test of all overhead console components.
Silence Button	—	Silences the alarm buzzer.	Press to silence the alarm buzzer.

Control Module Functions			
Item	**Display**	**Function**	**Action Required**
Silence Engaged Light	On	Indicates the buzzer is active but silenced.	Suspend vehicle operation immediately and follow alarm procedures.
	Off	Normal condition.	None required.

Table 16.2, Control Module Functions

Overhead Console Test

Press and hold the *Push To Test* button for one minute. The system will proceed with a self-diagnostic test that will include illumination of the *Trace* and *SIGNIFICANT* gas concentration lights, and the sensor fault lights. Verify the large red light and buzzer activate, and that all lights illuminate or flash to ensure that all bulbs are operational.

Sensor Test

The gas detection system sensors must be tested using certified test gas, which can be purchased as part of a test kit. Testing with alcohol or heavy gases such as butane or propane does not satisfy CCR § 935 (2) or NFPA 52 regulations.

Expose each sensor to certified test gas for at least thirty seconds. The system will proceed through the alarm procedure consistent with a significant leak and the buzzer will sound after approximately fifteen seconds. If a sensor fails to respond after exposure to the test gas, replace the sensor.

Engine Starting

NOTE: Before starting the engine, read **Chapter 3** for detailed information on how to read the instruments and **Chapter 4** for detailed information on how to operate the controls. Read the operating instructions in the engine manufacturer's operation manual before starting the engine.

1. Before engine start-up, complete the engine pre-trip and post-trip inspections and maintenance procedures in **Chapter 11**.
2. Ensure the fuel shutoff valve is open.
3. Set the parking brake.
4. Ensure that the transmission shift control is in Neutral (N), Park (P), or the Park Brake (PB) position.
5. Without starting the engine, turn the ignition switch to the ON position (**Fig. 16.7**). The electronic gauges on the instrumentation control unit (ICU) will complete a full sweep of their dials, the warning and indicator lights will illuminate, and the buzzer will sound for three seconds.

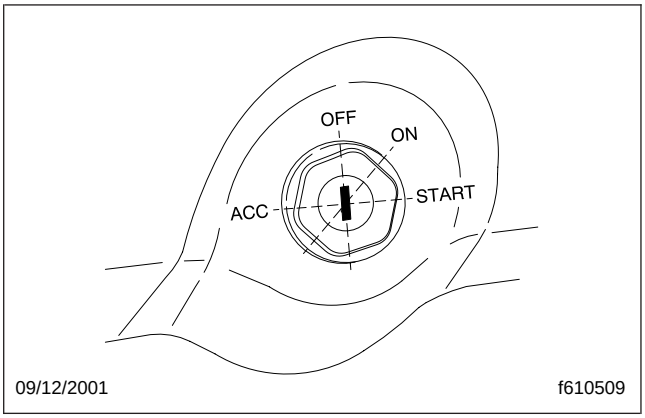

Fig. 16.7, Ignition Switch Positions

6. Turn the ignition switch to the START position.

   Press down on the clutch pedal, if equipped, but do not press down on the accelerator pedal.

   Release the key the moment the engine starts.
7. Bring the engine up to operating speed gradually as it warms up and develops stable oil pressure. If the vehicle has not been operated previously in a 24-hour period, allow the vehicle to idle for five minutes.

NOTICE

Do not rev the engine if the oil pressure gauge indicates no oil pressure. Shut down the engine

within approximately ten seconds to avoid engine damage.

8. Check the oil pressure gauge for any drop in lubricating oil pressure or mechanical malfunction in the lubricating oil system.

Major Repair and Replacement of Parts

If a natural-gas-fueled vehicle is involved in an accident, remove the fuel tank or cylinders from service and have them inspected by a qualified technician. Replace any leaking or damaged fuel tanks/cylinders and fuel lines; repair or replace leaking or damaged fittings. Install parts and components in accordance with the manufacturer's instructions.

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